NEW YORK • LONDON

WORLD PETROLEUM

Need for Cooperation on British Market Seen • Petroleum Marketers Examine Aviation Sales • A.P.I. in Los Angeles to Discuss Government Control and Reserves • Laying a Pipeline in East Indian Jungle • British Hydrogenation Plant Opened by I.C.I.

NOVEMBER • 1935

FIFTY CENTS OR TWO SHILLINGS THE COPY

To you who are charged with the responsibility of managing a refinery–at a profit –this invitation is extended.

Through the past four years many such executives have accepted the invitation. Consulting with us in the cause of furthering profit –not in expanding thruput–has many times produced the answer to the profit problem.

Currently many new and important petroleum processing ideas require investigation of their correct application to your individual refining problems.

Leader again invites you to consult with its staff on Solvent Refining of Lube Oil, Solvent Dewaxing, Economic Limitations of Cracking, Conversion of normal cracking stocks into specialty products, increasing neutral yields from high priced crudes–all as they affect your individual business.

It's possible that our knowledge and experience will supply some factors essential to the increase of your profits.

LEADER INDUSTRIES, INC.

DECATUR, ILLINOIS · · · U. S. A.

NOVEMBER
1935

WORLD PETROLEUM

VOLUME VI — **Editor, E. W. Mayo** — NUMBER 11

CONTENTS

Frontispiece	658
Editorial	659
Foreign Oil Legion	684
Prices	685
Abstracts	689
Production	697

Special Articles

Oil Marketers Examine Aviation Sales	F. A. Maple	661
A. P. I. Meeting to Discuss Reserves in Los Angeles		668
Need for Cooperation on British Market		670
A. I. M. M. E. Annual Meeting Produces Interesting Discussion		671
Laying a Pipeline in East Indian Jungle		675
Billingham Hydrogenation Plant Opened		680

Published Monthly by

RUSSELL PALMER

56 West 45th Street, New York, U. S. A.

Cable Address, Ruspam, New York and London

Advertising Manager, S. J. Gallay

Executive-Editor, T. Orchard Lisle

London: 3 Savoy Place, Victoria Embankment, W. C. 2

▼

CALIFORNIA OFFICES: Bendix Bldg., Los Angeles
58 Sutter St., San Francisco

Subscriptions

ANNUAL subscription to WORLD PETROLEUM is offered at the flat rate of five dollars (U. S.) postpaid to any country in the International Postal Union, except in Canada where a special tax compels the publisher to charge $5.60.

For the convenience of subscribers the publisher will accept payment in any of the following currencies at the fixed rate shown below:

Argentina	15 paper dollars
Canada	5.60 dollars
Colombia	10 pesos
France	76 francs
Germany	13 Reichsmark
Great Britain	1 guinea
Holland	7 guilders
India	13 rupees
Iraq	1 guinea
Italy	61 lire
Japan	17 yen
Mexico	18 pesos
Persia	1 guinea
Peru	20.83 sol
Poland	26.43 zloty
Roumania	492.60 lei
Russia	1 chervonet
Venezuela	19.05 Bolivar

Remittances or drafts should be drawn to the order of the Publisher, WORLD PETROLEUM, payable in New York and London.

Subscriber's name and address should be in Roman capitals on the subscription order.

Official position of subscriber is requested.

Advance notice, if possible, of a change of subscriber's address should be given.

▼

Agencies

SINGLE copies of WORLD PETROLEUM are obtainable every month, within the delay imposed by the international mail service, at any of the following agencies:

CABIMAS, VENEZUELA—The German Store
CARACAS, VENEZUELA—Casa Letcher, Torres a Madrices 22
MARACAIBO, VENEZUELA—High Life Tailors
THE HAGUE—Martinus Nijhoff, Lange Voorhout 9
LONDON—World Petroleum, 3 Savoy Pl., Victoria Embankment, W. C. 2, telephone: Temple Bar 1735
A. C. Hardy, 100 Fenchurch St., E. C. 3
W. H. Smith & Sons, Ltd., Moorgate Met. Station
Willing & Co., Ltd., Moorgate Met. Station
Barker & Howard, Leadenhall Street, E. C. 3
NEW YORK—Telephone VAnderbilt 3-1095 for list of 20 newsstands carrying copies
WASHINGTON—Don J. Kirkley, Investment Bldg.
PARIS—Librairie Brentano, 37 Avenue de l'Opéra
PORT OF SPAIN, TRINIDAD—Davidson & Todd, Ltd., 8 Frederick St.
LOS ANGELES—Bendix Bldg., telephone: Prospect 9191
SAN FRANCISCO—58 Sutter Street, telephone: Exbrook 4855

The price of a single copy is 55 cents in Canada, 2 shillings in other countries of the British Commonwealth and the equivalent of 50 cents (U. S.) elsewhere.

▼

Particular Notices

CONTENTS of WORLD PETROLEUM are copyrighted by Russell Palmer, and contents may not be reproduced without permission.

Manuscripts and photographs submitted to the editor are received only at the owner's risk. Prompt consideration will be given to them.

The Publisher does not necessarily endorse the views expressed by authors of signed articles. In the service of readers he will not hesitate to give publication to signed opinions in direct opposition to his own.

Advertising rates obtainable on request.

A remarkable infra-red view of the Imperial Chemical Industries Company's Billingham plant in England which was officially opened on October 15 in the presence of distinguished guests, to manufacture petroleum products by hydrogenation of coal. The Cleveland hills may be seen in the background across the Tees.

NEW YORK • WORLD • LONDON

PETROLEUM

RESERVES of petroleum, their possible extent and the probable date of their exhaustion have been the subject of much discussion. This has been particularly the case in the United States where development has proceeded on a far more extravagant scale than elsewhere. Of late the topic has come in for renewed discussion in view of the fact—to which numerous commentators have called attention—that the bringing in of new fields within the past few years has not kept pace with the exhaustion of old ones.

Problem of Reserves

While no two authorities agree exactly as to the extent of the nation's known reserves an average of their estimates would be a figure somewhere in the neighborhood of 15,000,000,000 bbl. With consumption proceeding at the rate of roundly 1,000,000,000 bbl. yearly this would point to the exhaustion of known available supplies within the next decade and a half.

As a matter of fact nobody expects this as an actual result. Existing fields cannot be fully produced within that period. Long before the actual exhaustion of supplies the prices of petroleum products will rise to a point where consumption will be sharply checked and substitutes will be brought into use.

Moreover, new sources of supply are certain to be developed. Through geophysical surveys and the use of more scientific methods the location of promising structures has become a far more exact procedure than it was even a few years ago. The possibilities of deeper drilling and of redrilling of old fields have only begun to be explored. Means of recovering a larger proportion of the oil contained in producing fields are being devised. Through all of these methods considerable additions to existing reserves are likely to be made in the future even though no new fields of large flush production, comparable for example to East Texas, are brought in. Such a development of course is by no means beyond the realm of possibility.

▼

WHATEVER may happen in this direction nobody contends that the oil resources of any part of the world are inexhaustible. Consequently there is every reason to avoid needless waste in their exploitation. Conservation of existing supplies is recognized as necessary and laudable, even by those who do not practice it. True conservation, however, looks to the orderly and economical utilization of petroleum resources and not to the arbitrary limitation of their use, though the latter interpretation is too often given to the term.

New Supplies Are Essential

No matter how carefully and scientifically the known reserves of the United States may be husbanded it is obvious from the figures already stated and from other statistics that are available that new sources of supply must be developed if the users of petroleum products are to be provided with adequate quantities of these products at anything like present prices, or even at prices substantially higher. Drilling must be kept up. It is estimated that 20,000 wells must be sunk every year in order to keep pace with rising requirements. Old fields must be produced to the limit of their possibilities through the perfection of economically feasible methods and constantly improved equipment. New fields must be prospected and developed. Vast sums must be invested with full recognition of the fact that a large proportion of the investment will be irretrievably lost.

▼

AVOIDANCE of waste in drilling and production and postponement of the day when waning supplies will impose a sharp curtailment of use have been advanced as arguments for federal control of oil. It has been assumed that the national government would handle the situation with greater wisdom and success than individual operators or even individual states. A careful consideration of the subject raises a very definite question as to whether this would be the case.

Preservation of Initiative

Discovery and development have gone on rapidly in the past because they were open to free competition. Any man who has been willing to risk his time and money has been at liberty to drill. The wildcatter has penetrated to almost every part of the country, putting down wells that more often than not returned less than they cost, but hoping always for an ultimate strike that would repay all his efforts. The larger companies spend millions of dollars yearly in exploration and surveys of areas that often have produced nothing but disappointment and loss.

Under government control it would be necessary to obtain a license before drilling could be undertaken. Government officials undoubtedly would adopt a conservative attitude in granting permits. The opinions of government experts would dictate where drilling could be done and production would be

hedged about with restrictions that might make the risk of test well drilling unattractive to capital. Exploratory work would be slowed down and the probability of important discoveries would be lessened correspondingly.

To meet the growing needs of industry it is important that there be no let up in the uncovering of new supplies. With unimpaired freedom of action the search for additional resources will go on vigorously wherever men may think that there is a possibility of success. The oil industry has demonstrated its readiness to live up to the requirements of its position in this respect. What it needs is encouragement to satisfy industrial demands without undue enhancement of costs. Laws that will prevent waste and require the orderly production of fields once they are uncovered will be helpful, but the imposition of such laws is clearly the function of the states. Prevention of waste without restriction of enterprise should be the keynote of oil policy for the industry itself, for the states and the nation.

▼

Mysterious News "Leaks"

NEWSPAPER revelation of negotiations between representatives of the Soviet Union and a leading international company for sale of the entire export supply of Russian oil apparently has had the effect of embarrassing the negotiants. A deal of this sort would not affect the world's supply of oil while it might offer certain advantages to the parties directly concerned. It would relieve the Soviet oil organization of the necessity of maintaining expensive marketing facilities in other countries and it would tend to make easier the stabilization of certain markets that have been most disturbed during the past few years.

In the present strained and nervous state of international relations, however, anything that can possibly be conceived to give one nation or one group of private companies a preponderant control of oil supplies from any part of the world is certain to be viewed with suspicion and to be opposed by those nations and interests who may see a possibility of finding themselves placed at a disadvantage thereby. Witness the furor created a month ago by the mere announcement of a concession for exploration in Ethiopia! The time is especially unpropitious for any action that gives an opportunity for raising the cry of monopoly. This fact may not have been entirely absent from the minds of those responsible for this latest mysterious "leak" of information.

The knowledge that these particular negotiations in regard to Soviet oil were under way has been in the possession of this and other oil journals for some time but publication had been withheld in order not to interfere with their progress. The daily press of course feels no obligation on this score and is interested only in publishing what it regards as live news. In its pursuit of this objective it frequently prevents the consummation of constructive efforts.

▼

Fuel Policy for Britain

ON THE occasion of his installation as President of The Institute of Fuel early in October Sir John Cadman frankly discussed the fuel situation in Great Britain and outlined a policy which the government might well consider carefully. Grasping firmly the nettle of coal vs. oil Sir John showed clearly that there is no necessary antagonism between the two industries and that official efforts to aid the one by putting obstacles in the way of the other result merely in placing British industry under a handicap in international competition.

Without blinking the fact that the use of oil fuel, particularly in the marine trade, has been a factor in reducing the demand for coal Sir John pointed out that it is far from being the only factor, or even the most important. Development of foreign coal mines and the entry of other countries into international markets have lessened British exports. Of even greater consequence has been the progress in fuel economy which has been estimated to have been responsible since 1920 for a reduction in British coal consumption of 25,000,000 tons annually. Direct displacement of coal by fuel oil within the country has been relatively slight as is shown by the fact that oil constitutes less than one percent of the total volume of fuel used in industrial plants. The rapid expansion in demand for oil as fuel has come through the spread in the use of motor cars and more recently in the growth of aviation, to neither of which industries is coal suitable. The fact is that from a combination of causes the demand for coal has lessened and there is little prospect of any considerable rise in the near future. In the apt phrase employed by Sir John, "The size of the coat has become smaller and the cloth must be cut accordingly."

The proper aim of British policy toward fuel is succinctly stated by Sir John as being one of giving British manufacturers every advantage that can be obtained from ample supplies of cheap fuel. If fuel costs are made high by excessive taxation manufacturing costs are increased. In the export field high costs give an advantage to competitors and British trade must decline. In the domestic market if higher costs are reflected in higher selling prices the result is reduced demand, lower profits and a diminished standard of living for consumers.

Penalising oil cannot restore coal to its former position nor can the industry be made strong by subsidies and preferences. It can be aided only by a recognition of changed conditions and adaptation to existing requirements.

▼

Standard Oil Co. of California

Pan American Airways, Pacific Clipper being refueled at Alameda, California, for a trans-Pacific flight to Guam. This run is being used partly for a testing laboratory for future trans-Atlantic passenger flights.

Oil Marketers Analyze Aviation Sales

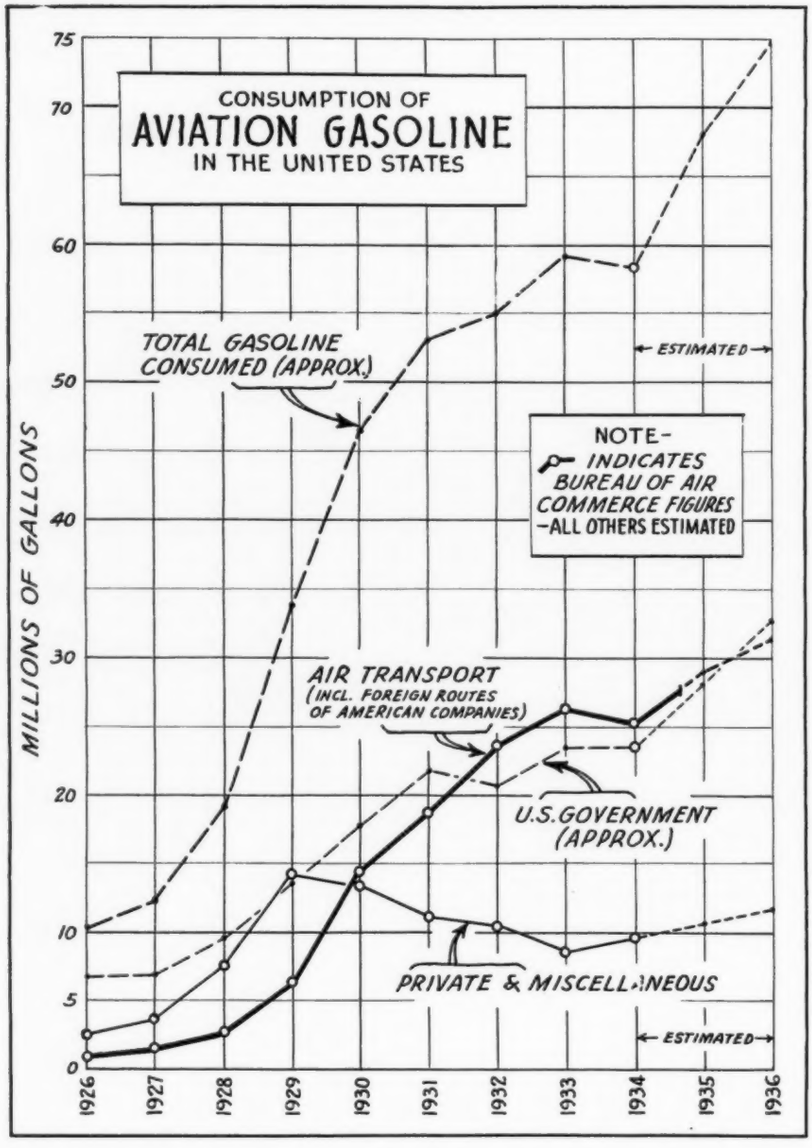
Petroleum Industry Has Invested Heavily in Development of Present-Day Aviation and Now Seeks Fairer Return on Investment Through Sounder Sales Policies. ***By A. F. Maple***

AVIATION, from almost the very day that it aspired to become a recognized industry in the United States, has met with adversity. Hailed as a child prodigy in 1927 it was taken on a grand tour, amid the flurry of stocks and ticker tape, to perform for the public. By 1929 the people were convinced of its greatness and its splendid future, when the bubble burst. The poor infant was left standing on a deserted airport broke, weak, and alone. After recovering from the great shock, the youthful industry looked around and having confidence in itself and its future, even if the public did not, went to work. During the years of the depression, when most stronger and older industries were finding the going difficult, aviation grew and grew very sturdy for its tender years. Its most true and helpful friend during this trying period was the oil industry.

Now, the growth and development of airplanes and air transportation in the United States since 1930 is too well-known to need any recital of the facts here. However, a graph showing the relative progress and consumption of petroleum products based for the most part on Bureau of Air Commerce records is shown on these pages.

Fifteen years ago an airplane was just that, and it was used for whatever job was to be done, but today we find the industry divided into three general classes, each tending more and more to go its own way. Air transport is the most important of the three, economically, and will continue to be, at least for some years to come. Military aircraft, while it represents today, nearly twice the expenditure that air transport does, is not destined to hold the limelight very long, unless a major war develops. Private and miscellaneous aircraft lags far behind and is, at present, the despair of many aviation enthusiasts.

For several years now, private flying has been thought about ready to blossom



About $10,000,000 will be spent in the United States during 1935 for aviation fuel and lubricants. The forecast for 1936 gasoline sales, as shown on the chart above, is encouraging. Bureau of Air Commerce figures for 1934 show a total sale of 2,158,288 gallons of oil broken down as follows: Air transport, 838,756 gallons; Government aircraft, 970,547 gallons; and private and miscellaneous, 348,985 gallons.

forth and prove its claim to having great potential possibilities. So far it has little more than held its own, but its future seems certain.

The general design and performance specifications for the three different types of aircraft are growing farther apart every day. Designers and builders of each type are seeking to produce planes which are best adapted to the work required. There is certainly no point in providing the extreme manoeuverability, speed, and structural strength of a military pursuit ship in an airplane to be used by a middle-aged business man in travelling from town to town, nor can the efficient transport plane be trimmed down to the size and needs of the private flier. Each type of airplane must be carefully designed to fulfill its purpose and the engine is as important, or more so, than the rest of the ship. It too, must be designed with a thought to its use. Engines are changing and those of tomorrow will demand a better grade of fuels and lubricants.

The Army and Navy are interested in performance, especially at high altitudes, and performance in the modern engine goes beyond the supercharger. It now depends more than ever on the fuel used. Within the past year iso-octane has been refined in sufficient quantities to be used in blends for experimental purposes. The results of extensive tests indicate that iso-octane will unquestionably be used in future gasolines for the military forces and probably for the airlines.

For the past seven years there has been a steady increase in the anti-knock or octane number rating of gasolines. Airplane engine designers in their effort to increase the power output of their engines, without adding to the weight, have been quick to take full advantage of every improvement in the anti-knock quality of gasolines that refiners have been able to produce. Little by little they have increased compression ratios. On top of this has been added increased supercharging and the net effect is increased working pressures in the cylinders. In other words, the supercharger forces in more air and the increased compression ratio causes it to be squeezed up tighter. Only with improved fuels which tended to prohibit detonation were these advances possible.

So, the march of the octane numbers started from about 50, rose to 60, 73, 87, and not long ago made a brief halt at about 92. This for a moment, was as far as the refiners could go, and there was plenty of trouble even with 92 octane gasoline because of too great a portion of tetraethyl lead used to make it. More than the 3 ccs. of lead commerciably allowable has caused considerable engine trouble due to excessive hot and cold corrosion. With the development of iso-octane in commercial quantities a blended gasoline of 92 octane (U. S. Army test method) or about 88 octane (CFR motor test) is possible without the use of lead. When 3 ccs. of lead is added, however, the octane number is raised to about 100. This 100 octane gasoline has no more detrimental characteristics than any other gasoline containing an equal concentration of lead.

In tests conducted by the U. S. Army Air Corps it was found that 100 octane gasoline is highly efficient and that there is an increase in power of from 15 to 30 percent at low altitudes with existing high output engines. When 100 octane fuel is used, as was brought to light in the Army tests, full throttle operation at low altitudes is now possible, as is a steep rate of climb, without the engine overheating. It should not be overlooked, however, that in developing this additional power with existing engines the rotating and reciprocating parts in the engine were overloaded. With engines specially de-

New four engine Boeing bomber now undergoing army tests and expected to prove one of the world's most efficient and fastest bombers.

signed for 100 octane fuel an even greater increase in performance is anticipated.

The marketing of iso-octane blends of from 92 to 100 octane number (U. S. Army, modified CFR test) will add somewhat to the problems of many oil companies. It is reasonable to believe that the military services will increase their demand for an iso-octane fuel. Engine manufacturers will produce more and more engines designed to operate on this higher efficiency gasoline, and then the airlines may find it both advantageous and profitable to use it.

The chief engineer of one of the major airlines, when asked in a questionnaire, whether or not he thought the airlines were likely to adopt the use of 100 octane gasoline within the next few years, replied that he did not think so, because engines now under development and likely to be used by the airlines during that period do not contemplate the use of higher than 87 octane (CFR). He continued further with the opinion that 80 octane aviation fuels must be and can be produced without the use of any lead, and 87 octane with a minimum of lead, at no appreciable increase in cost.

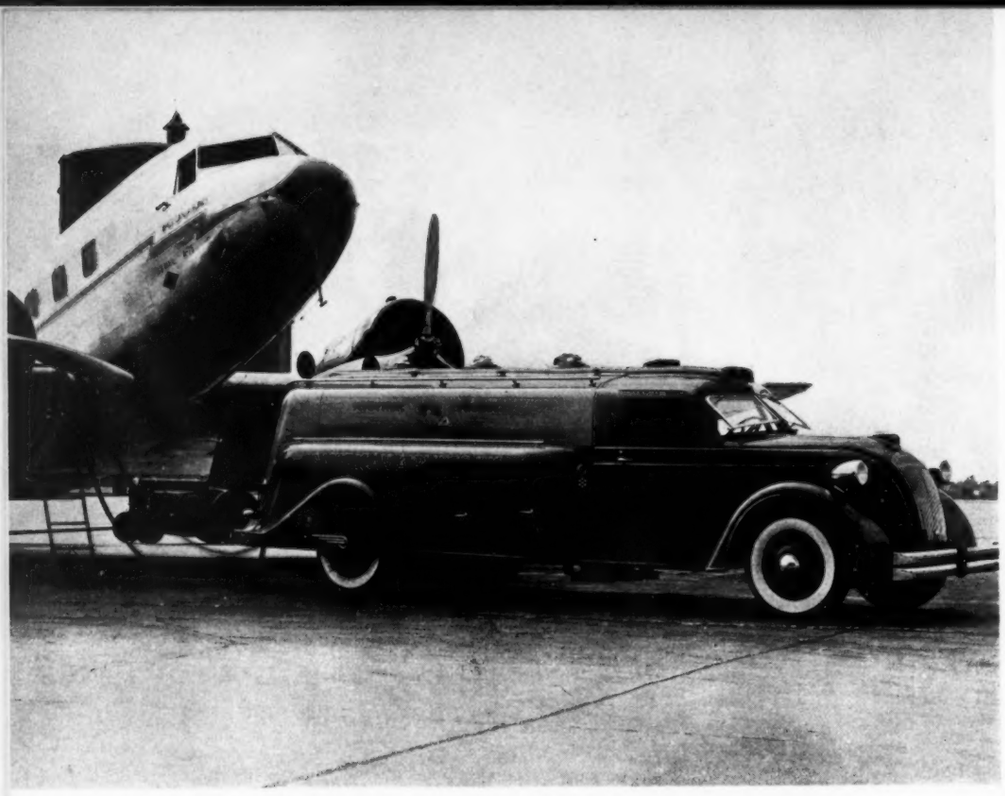
Two other leading airline engineers answered the afore-mentioned question with a "yes," one of them with the reservation, "if the price is not too high."

Some of the airlines, it is said, are now preparing to experiment with 100 octane gasoline for taking off and climbing to the desired altitude and then changing to 80 or 87 octane for cruising. However, the limited supply and high cost of iso-octane blends for several years to come may deter transport operators from a too rapid conversion to its use. But even so, the fact is not to be overlooked that the use of iso-octane blends in present-day engines is largely for the purpose of minimizing the lead content and thus obviating the difficulties inherent in leaded gasolines. And further, when engines are designed specially for these extremely high anti-knock fuels, it will be possible to derive more power from an engine of given size and weight and consequently increase the payload which an airplane can carry. When this is brought about, it seems logical that transport operators can afford to pay a substantial premium for this fuel and still profit from its use.

One of the next great strides in air transportation will be higher altitude or even stratosphere flying, in which event it seems likely that iso-octane gasoline will be a practical necessity.

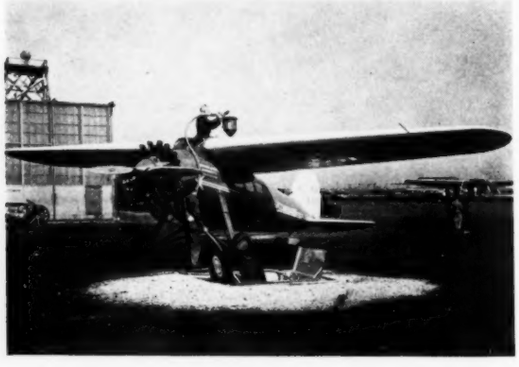
It is understood that only two companies, Shell and Standard Oil (N. J.), have completed refinery equipment and are now selling 100 octane gasoline for from two to three times the price of 87 octane. The Army is now paying about 25 cents a gallon f.o.b. refinery. This gasoline is said to be a blend of about equal portions of iso-octane and 73 octane (CFR) white aviation gasoline plus about 3 milliliters of tetraethyl lead per gallon.

So far, iso-octane, a synthetic product, has been produced only in the United States. Its manufacture is a complicated and costly process and the initial cost of the special refining equipment required is very great. The high manufacturing cost, exclusive of equipment amortization, is due largely, however, to the expense of hydrogenation. It seems probable that the price of iso-octane blends will stay high, as compared to the price of ordinary gasolines, and that for the



American Airways Douglas at Detroit refueling from the most modern and efficient type of tank truck.

A Sikorsky amphibian used by Pan American Airways for Caribbean transport.



Typical airport pit refueling; a Lockheed Vega plane at Newark airport.

time being only a limited number of refiners will be able to market it.

The most important task confronting refiners today is that of developing better lubricating oils for use in high output aero engines. The best grades of mineral oils sold by American marketers and now being used, leave much to be desired. Technical research men and petroleum chemists of prominence frankly admit their inability to solve the problem in the light of their present knowledge of lubricants.

The vital part played by lubricating oil in the safe and economical operation of an airplane is apparent. With the development of new engines with even higher output and greater engine pressures, such as those which will use 100 octane fuel, the lubricant will be subjected to higher temperatures and greater loading of the frictional surfaces. Therefore, aero oils should have a higher lubricating value, or oiliness, and have a greater resistance to the deteriorating effect of high temperature.

For the time being, it is generally admitted, the only hope lies in a compounded oil. Commercial airplane operators are, of necessity, concerned with operating and maintenance costs. The frequent replacement of parts, badly worn because of inadequate or faulty lubrication, is expensive. The cost of frequent engine overhauls is great, as is the cost of heavy oil consumption in the running engine. Those who look with favor upon compounded oils, as opposed to straight mineral oils, invariably back up their opinions by pointing to the experience of European airlines which have been using this type of oil successfully for several years.

In Europe many of the airlines, using compounded oils in engines of American, British, French, and German manufacture, run them from 500 to 700 hours between overhauls, whereas formerly they got only 300 to 400 hours when using mineral oils similar to those used in the United States.

At any rate the comparative tests conducted with mineral and compounded oils in American engines have been sufficiently favorable to cause the belief that compounded aero oils will be featured on the American market before long.

In the meantime petroleum technologists are working diligently with the problem of improving lubricants, and the engine manufacturers are searching for new metals or alloys, and possible treatments of them, which would improve the lubrication of high output aero engines.

Notable is the tendency of new engine manufacturers toward simplified lubrication, i. e. that all moving parts are automatically lubricated under pressure. The elimination of external parts, which need to be individually lubricated at frequent intervals, will reduce maintenance costs. Except for spark plugs, magnetos, and possibly some valve adjustment, these engines will need no servicing, other than a periodic check, between major overhauls which are required every 400 or 500 hours.

About ten years ago the Army Air Corps started the development of mechanisms which would meter and inject fuel into an aircraft engine. The performance of carbureters during inverted flight or tactical maneuvers was not altogether satisfactory and it was, apparently, with a desire to overcome this weakness that the study of fuel injection was begun.

There has also been another serious weakness, that of ice formation in the carbureter of high output engines under certain operating conditions and temperatures. Fuel injection has the distinct advantage of eliminating any possibility of ice forming in the fuel system and thus it becomes an added factor of safety.

The mechanism, now quite well developed by the Army, is understood to be in use on a large number of Air Corps planes. Probably the most interesting thing about a fuel injection system to the oil man, is the marked increase in power of an engine

so equipped, as compared to the output of the same engine fitted with a carburetor. The increase in power or operating economy resulting from fuel injection is probably caused by improved fuel distribution. The greater consumption of air may help some, too. At any rate, in the carburetted engine it is very difficult to deliver an equal portion of a uniformly mixed fuel charge to each cylinder. Fuel injection, by overcoming this inefficiency, makes possible about 10 or 15 percent more power.

Airline operators are watching the development of compression-ignition engines with interest. Many of them are inclined to feel that in the near future the heavy-oil engine will demand serious consideration because it has some outstanding factors in its favor. Diesels have had much more thorough study and testing in Europe than in the United States, and are now being used experimentally on the Lufthansa transports operating in Germany. There is a sound economical reason for the swing to oil engines in Europe, but that same reason is lacking in the United States. Germany and Italy, in particular, lack petroleum reserves and consequently have turned to the use of vegetable oils and alcohol blends as much as possible. Because it is scarce, European prices of good aviation gasoline are high compared with American prices. In Germany, it is said, about 65 percent of the fuel cost is saved by using oil instead of gasoline.

The cost and adequate supply of gasoline not being factors, the development of Diesels in the United States has not been pressed, but other oil-engine features are sufficiently alluring to sustain the belief that the Diesel will have to be reckoned with in American transport aviation before very long. The use of the oil engine promises increased duration of flight because of more economical consumption. Although, of necessity about 30 percent heavier than the gasoline engine, the fuel consumption of the Diesel is, in pounds per horsepower hour, much lower. Therefore, it is well adapted to long flights where the initial increased weight of the engine can more than be made up by the reduced weight of the fuel carried. At high altitudes the compression-ignition engine is better able to retain its power than is the supercharged gasoline engine. These advantages become less, however, with the present trend toward increased gasoline efficiency.

The problem of radio shielding for the electric ignition system of the gasoline engine is eliminated in the compression-ignition engine. The fire and explosion hazard is reduced by the use of oil instead

Putting 510 gallons of gasoline and 120 quarts of oil in a Transcontinental and Western Air, Inc., transport ship in less than five minutes.

of gasoline, and this safety factor appeals to airline operators for obvious reasons. But, the fact should not be overlooked that the risk of fire following a crash and the spilling of fuel on hot exhaust pipes is possibly greater for oil than gasoline because of the low self-ignition temperature required in a Diesel fuel. In other respects, however, the danger of fire is diminished.

Although there are several makes of airplane Diesel engines on the market in the United States the common impression seems to be that they are not, as yet, all that an airplane engine should be. There are many mechanical and thermodynamic problems yet to be solved, and so in many shops throughout the country experimenting and testing continues under way. A few single-engine planes powered with Diesels are in service, but they are not popular even though their performance is, in many respects, excellent. Possibly one reason for this is the difficulty of obtaining oil fuel at airports, as there is of course no general distribution of the product. It can be obtained only by special order.

Obviously the greatest factor in retarding the growth of private and miscellaneous flying has been expense. Airplanes have cost too much, and the upkeep and cost of operation has soured many men who had the courage to leap over the original cost barrier. Hangar rent, maintenance and repairs, insurance, gasoline and oil cost so much more today than they should, that owning an airplane is still a rich man's privilege.

There are probably from five to ten thousand qualified pilots in the United States who do very little, if any, flying. It is not because these men and women do not want to fly that they stay on the ground and let their licenses lapse, but simply because they can not afford to fly. Tens of thousands of youths in the country have been building model airplanes and dreaming of the day when they will learn to fly a real airplane. Thousands of them are old enough to take instruction today, but the son of even a moderately well-to-do business man can not hope to get six or eight hundred dollars to pay for just learning to fly and getting a private pilot's license. What will he do with it after he gets it? To rent a plane costs from ten to twenty dollars an hour: this makes the practice necessary to keep one's hand in, rather expensive. The reason that thousands of men and women are not flying today for pleasure or business is not that they are afraid, or lack the ability to learn to fly safely, but simply because the cost is too great.

There was a day when the average man could not afford to own and operate an automobile any more than he can own an airplane today, and therefore, we must assume that there will be a day when the average man, who so desires, can afford to own and operate an airplane. When the price of the various items and services that go to make up the cost of travelling in the air, rather than on the highway, are eventually reduced to their proper level, the cost per mile of operating a light plane will be about the same as that of a good automobile. Until that day arrives, the volume of oil and gasoline sales to private fliers will not amount to much.

The time appears to be close at hand, however, when significant steps will be taken to increase private flying by reducing costs. Tests being conducted at the present time by the Bureau of Air Commerce in an effort to evolve a light plane for quantity production, which is safe, easy to fly, and which will sell for about a thousand dollars, are encouraging. Several of the planes built experimentally this year for the Bureau show definite promise.

One of the foremost problems in producing a cheap plane is to get an inexpensive engine. Two or three automobile powerplants have been tried in ships specially designed for them and have proved satisfactory in most particulars. However, the automobile engine's weight in pounds per horsepower is so great that these planes can not give all that is desired in performance. Motorcar powerplants also have the temporary disadvantage of running at too high a speed for use in airplanes without the use of reduction gears or belts. Undoubtedly, some sound developments will emerge from the experiments being conducted and before long several less expensive airplanes should be available for the private flier.

From all indications private and miscellaneous flying in the United States will have consumed well over 10,000,000 gal. of gasoline and 1,000,000 gal. of lubricating oil during the current year. It would seem, if one were to hazard a guess, that this portion of the petroleum market devoted to private and miscellaneous flying should increase slowly for two or three years and then more rapidly. In five years it will probably amount to a little more than 20,000,000 gal. of gasoline per year.

Let us now take a look at the average airport as if it were a dealer service station and see what the situation is. Only a small percentage of the airports in the United States are fortunate enough to have scheduled transport service operating from them and thereby be assured of a regular source of income, in the form of fees, to the airport operator. This means that those not so fortunate, have to look to the private and miscellaneous plane owner, both local and transient, for support. Of the products and services sold, oil and gasoline are the leaders in producing a steady and adequate revenue. Thousands of airports have relied on the sale of petroleum products to keep them in business for the past few years and their staying in business has been vital to the progress of aviation. The average airport operator is able to realize approximately 40 percent of the retail price of petroleum products as gross profit. Of this retail price the refiner and marketer gets only about 40 percent, which, considering the small volume, does not leave much net profit. The remaining 20 percent on an average goes for taxes. The oil industry has felt that airports are as important to the increase in airplanes as good roads were to automobiles; without good landing fields airplanes are of little value. For this reason alone, if for no other, the development of airports has been encouraged and should continue to be by all interested parties.

The oil companies in many cases, however, have been generous to a fault in being helpful to the airport operator. They have not been actuated altogether by the spirit of big-hearted paternalism toward aviation, quite frequently it has been merely the pressure of competition. Petroleum marketers are assumed to be in business, and that implies the necessity of making a fair profit from their sales. In many cases it is suspected that they are taking an actual loss on airport business. These deals are usually justified in the minds of the doers because they need the representation, the volume is insignificant, or because it is good advertising to have some particular account. Such deals usually can not be considered as lying within the limits of sound business practice, but worst of all they are, quite often, not even properly posted on the books. They are, in many instances, set down as a direct loss against aviation sales, rather than in a manner to show the proper profit for aviation sales and the deficit charged against advertising or something else. Aviation sales departments can, and should, stand on their own feet, but to do so it would seem that they must sell their products at a price which will yield a fair return and that they must refrain from turning around and giving the profit back to the customer in the form of extra equipment.

From casual observation, it appears that the signing of longer term contracts would help both parties to the agreement by enabling the airport operator to get his

Refueling one of the famous small Howard racing planes at Buffalo, N. Y.

products, equipment, and service at a fair price and at the same time give the oil company time enough to make the investment pay. An airport account should be analyzed in the same light that a dealer service station is, except that the greater per gallon investment usually involved should be overcome by the benefits of a longer term contract.

A reduction in the cost of flying will undoubtedly have the effect of increasing the amount of flying and consequently boosting the volume of sales. This train of thought always provokes the question; when will it be possible to reduce the airport dealer's margin, from the ten or twelve cents that is common today, to an amount more nearly comparable to that of the service station operator?

Petroleum refiners have labored for many years at great expense to develop, perfect and supply the gasolines, lubricating oils and greases which together make present day airplane operation possible. There could have been no real development of flying without the research work of the refiners. Year after year they have improved their products so that aviation could progress. This fact unfortunately has been overshadowed by the spectacular feats of aviation, and it is suspected that the general public is quite unaware of the important role played by petroleum technologists in this drama. Possibly the aviation industry by and large does not appreciate the fact as fully as it should.

Aviation products are sold in the United States at a very low price, considering the cost of research, testing, refining and marketing. Although the performance value of aviation gasoline has increased tremendously in the past ten years, the price generally, has hardly increased at all. A marked improvement in the performance ability of a gasoline has seldom been accompanied by an increase in price. In passing this value on to the airplane operator, aviation has been aided and encouraged.

It would seem to an observer, however, that the day must come when products will be sold at prices more in keeping with their value than they are today.

The tendency displayed by some marketers to obtain contracts with the government and with airlines by bidding so low as to almost preclude the possibility of making any profit, can only be defended on the grounds of supposed prestige or publicity value of the contract. Today the advertising or publicity value of most aviation accounts can be seriously questioned.

Aviations' news value is, unfortunately, still fairly good in the wrong direction—newspapers still persist in favoring an airplane accident with prominent headlines and space location. But in most other respects the public is not particularly impressed today by aeronautical happenings.

If the present marketing situation is analyzed, it will show the need for closer adherence to business principles. The aviation sales departments of all oil companies would, it is believed, benefit by operating in such manner and with such policies that their actual profit or loss position is made obvious. Accurate knowledge of just where they stand should enable them to conduct future transactions in a manner which, when reckoned over a period of time, should be advantageous to all parties concerned.

Aviation is now a business—a business which, as time goes on, will handle an ever-increasing portion of the world's transportation.

Axtell J. Byles, president, American Petroleum Institute.

T. O'Donnell, American Petroleum Company.

Ralph B. Lloyd, president, Lloyd Corporation, Ltd.

Reserves to be Main Topic at A.P.I. Meeting

R. D. Matthews, executive vice president, Union Oil Company (top) and J. A. Crawford, president, the Republic Supply Company of California (below).

At One of the Most Important Gatherings of the Members of the Industry in Recent Years, a Policy in Regard to Federal Control Attempts Must be Formulated and Oil Reserves Estimated.

BECAUSE of the very active and growing interest in the extent of available reserves of crude oil in the United States and the further keen interest in the next moves to be made by the federal government in its attempt to take over control of the petroleum industry, the Sixteenth Annual Meeting of the American Petroleum Institute, scheduled to start in Los Angeles on November 11 promises to be an unusually interesting and significant one.

In some respects the meeting may be said to have started weeks before the actual convention opens. Committees and individuals have been working intently on various methods of estimating reserves within the United States, the raw material to be digested at the actual meeting. The fact that new flush fields are not being discovered at a rate sufficient to keep pace with consumption of products may suggest to those attending the annual meeting the necessity of keeping all channels for further exploration work open. So many able estimates of remaining reserves will be available at the coming meeting that an average of the individual figures should give a fairly accurate picture of the true situation. It may be expected also that informal discussion will concern itself primarily with the best national policy to adopt in regard to producing crude oil in the future.

Inevitably, informal discussion, as well as the formal papers, will consider the possibilities of a further onslaught by the federal government designed to centralize control of the oil industry in Washington. It is even possible that the question of reserves will have some bearing on the willingness (or unwillingness) of the industry to accept federal control. Obviously anything that tended to discourage

C. E. Olmsted, The Texas Company, Los Angeles (left), K. R. Kingsbury, vice president at large, American Petroleum Institute, and president of Standard Oil Company of California (center) and R. A. Broomfield, Barnsdall Oil Company, of California.

oil prospecting at this time, particularly if the Institute finds that reserves are less than expected, would not be in the public interest.

President Byles' speech, to be delivered on November 12 is being anticipated with unusual interest by the members of the industry who plan to attend the annual meeting in large numbers. President Byles' speech will deal with the history of the development of the industry down to the present, the services it has rendered the nation and its progress, made so far without the necessity for federal control.

The oil industry and the institute which represents it favor state control, particularly in so far as it attempts to bring supply and demand into balance, conserve resources and prevent waste. An address by Governor E. W. Marland of Oklahoma, former oil man, is expected to treat the subject of state vs. federal control. Governor Marland is chairman of the Interstate Compact Commission recently authorized by act of Congress.

As in former years a large number of excellent technical papers have been prepared and this year perhaps, more than at any time in the recent past, a large amount of interesting material will be available. Progress in production and drilling technique has been so rapid recently that consideration must be given to a number of new developments whose importance in the changing oil picture may not yet be fully realized. The division of refining will also have a number of new developments to consider, and meetings in this division promise to be extremely interesting.

The choice of California as the location for this year's meeting serves to call attention to the exciting oil history of that state which has not always followed the evolution of the other oil producing states. The last California meeting of the A.P.I. was in 1926.

While the existence of oil in California was known from the beginning of its settlement and seepages were identified as early as 1860, the first well was not drilled until 1867 on Sulphur Mountain. The first refinery was constructed at Newhall in 1875 and has now been reproduced as a monument to the contribution that the California oil industry has made to the national economy. Four years later the first pipeline was constructed from production to the Newhall refinery. In 1895 the state's production passed the 1,000,000 bbl. mark for the year and by 1906 the industry in California was suffering from overproduction which was relieved when it was demonstrated that fuel oil was suitable for use in locomotives. Since then California has contributed many valuable technical advances to the business of producing, refining and utilizing oil products. At present the state has some 16,000 producing wells, 63 operating refineries, over 6,000 miles of pipeline and storage facilities for 233,464,000 bbl.

W. C. McDuffie, Receiver, Richfield Oil Company of California (top) and W. F. Humphrey, president, Tide Water Associated Oil Company (below). On these two pages are shown men who are leading members of the American Petroleum Institute who have been instrumental in promoting the success of the Los Angeles meeting.

Need For Cooperation in Britain

U. K. A Favored Market — Are Distributors Missing Opportunities? — Independent Federation Offers Possible Solution

By Alec H. Day

CHANGES in Britain within the past two years have brought the motor spirit market to a stage where distributors may be losing a golden opportunity for the lack of cooperative effort. This is the view which is now being entertained by a widening circle of oil men.

In the first place, fundamental conditions have altered immensely for the better. Britain has shown a strong and increasing power of absorption of all oil products, and the trade has escaped serious interference from the government. The British market, therefore, in addition to being the second largest in the world, should by now be one of the most favored from the seller's viewpoint.

Almost concurrently with the basic strengthening of market conditions, a combination of independent distributors has been taking shape, and emerged some time since as the Independent Petroleum Federation, under constructive and efficient leadership.

With active consumption, and association of interests adopted among the independents as well as the national group, the stage should be set for prosperous trading, and it is therefore only natural that some observers should be asking how far misunderstanding and lack of appreciation of the other man's point of view are standing in the way of a rational handling of the market by the distributive industry.

Possibly an answer to this question is to be found in one of the main factors responsible for the Independent Federation's existence, for the necessity for meeting the opposition of the larger companies has been suggested as the Federation's principal *raison d'etre*. Elimination of competition, and the maintenance of as reasonable selling prices as possible between the independents themselves were undoubtedly strong incentives to combination, and a further objective of the Federation was to improve the trade status of the independent by giving his customers some sort of guarantee of fair dealing and financial stability.

Betterment of the general standing of the smaller firms outside the national group naturally carried the implication of exclusion of irresponsible distributors of the casual type from Federation membership. Measures were therefore taken to discourage the operations of any concerns which had been in the habit of cutting into the market at the most profitable points with a purchase of a part cargo and the temporary hire of road tank cars, thereby skimming the cream off the business without undertaking regular distribution. It was held by the Federation that casual distribution on these lines lent itself far too readily to the supply of inferior spirit, at the same time leaving the financial standing of the wholesale distributor in far too nebulous a state. The Federation therefore cut off supplies going to the unreliable type of independent by acquiring any stray cargoes offering. It is believed that this action has been effective in practically ridding the market of the in and out operator. In the process of elimination, the original list of possible members of the Federation was reduced by approximately 50 percent, and it may now be said of the independents that their official body has a good claim to represent substantial firms, including some of very old standing.

As an example of cooperative working, the organizations of the Federation presents several points of similarity with the national group, although working on a much smaller scale. It is no more a strict combine than the association between the national companies, for its members carry on their business on their own lines, subject to certain general restrictions, including a system of zoned minimum prices and the supply of spirit of a certain minimum quality. Federation members engaged in importing are said to be supported by a number of shippers in the Gulf and elsewhere, thus obtaining regular supplies, and in its selling operations the Federation, through its constituents, certainly has the good will and sympathy of numerous consumers who believe in keeping their purchasing market as competitive as possible. This applies particularly to buyers of commercial spirit for lorries and delivery vans, including some very well-known British industrial concerns.

The Federation now claims to embrace the whole of the independent distribution of the United Kingdom with the exception of such large unaffiliated undertakings, as Trinidad Leaseholds, Texas, and R.O.P. Membership totals about thirty firms, many of them possessing their own laboratories for testing the quality of the spirit handled. An estimate of the annual turnover of members puts the total at well over 100,000,000 Imperial gallons, of which 60 percent is conducted on contract with commercial users, the remainder consisting of sales to the retail trade. Official figures of motor spirit entered for home consumption in Britain during the first six months of the current year are equivalent to 1,175,000,000 gal. per annum, so that the Federation represents something like 10 percent of the British motor spirit market.

As a market factor, the establishment of the Federation derives its chief importance from the fact that it brings the 10 percent of total British motor spirit sales handled by the small independents under a single control. Under the conditions existing a year or so ago, this odd 10 percent was divided between numerous small and unconnected undertakings, and was subject to innumerable strifes and fluctuations. Although, therefore, it could at times cause a considerable disturbance to the price structure, it was handled by no tangible interest which could in any circumstances be brought into line with the rest of the market. To-day, marketing by the small type of independent distributor is under the control of a definite entity, and may therefore be considered as a single contributor to Britain's motor spirit selling organization, with total sales comparing favorably with any but those of the larger constituents of the national group.

If all that is claimed for the Federation is justified, it represents the only effective competition offered to the big companies by the smaller independents, and thus furnishes a means by which measures may

ultimately be devised for strengthening the price structure or otherwise improving marketing conditions in Great Britain.

That there is ample scope for steps in this direction is evident, since no one pretends that the British distributing industry is deriving full benefit from conditions which have become highly favorable. The country has escaped the profound disturbances caused on the Continent and elsewhere by government monopolies, import quotas, exchange clearing schemes and official measures to force the establishment of internal refining industries. Apart from heavy taxation, government interference in the British petroleum market has been an almost negligible quantity.

Despite the advantages of freedom and trade activity, the market can hardly be providing the majority of distributors with a reasonable return on capital invested. Unfortunately, the increase in the Trinidad Leaseholds dividend from 12½ to 17½ percent for the year to June 30 last cannot be considered a criterion for the whole market. Although some advantage must have been gained by the national companies from increased general gallonage, the profit margin is so small in motor spirit that after providing for overheads, this section of the trade cannot be yielding adequate compensation for many lean years. At their own lower level of selling values, the independents are not making a reasonable margin, and it is generally admitted that a further small increase in selling prices is overdue, and could be made without either alienating public opinion or sacrificing the goodwill of the authorities. From both viewpoints, the existence of the independents in the market is probably an advantage, for it eliminates the grounds for any accusation of a close monopoly by the national companies; and for the same reasons, perhaps, too close a combination between national and independent distributors might not be a desirable step. A definite association between them for trade purposes, however, might well prove a decidedly helpful and constructive development.

It may be frankly admitted that the big distributors in Britain have suffered considerable loss and inconvenience in the past from independent firms, through irresponsible marketing methods and price cutting in the most remunerative spots. In view of this experience, a reluctance to take independent interests into serious consideration is easily understood. Equally, mistrust of the big undertakings on the part of the smaller distributors is not unnatural. The effective operation of the Independent Petroleum Federation, composed of small firms of standing and at the same time giving the latter the strength of unity, should have done a good deal to remove the causes of distrust on both sides.

Since they are all engaged in the same industry, the interests of both large and small operators are, after all, united in many essentials. Aside altogether from fixing prices and allocating spheres of influence, there is ample scope for consultation and combined action between national concerns and independents. Resistance to oppressive taxation, joint observation of new entrants into an already overcrowded market, and limitations on the erection of superfluous pumps, instantly come to mind as possible matters for discussion. The length of trade credits, and facing the Customs authorities on the question of evaporation, are other subjects where completely comprehensive action would be more effective than any taken alone by the national group, powerful as the latter may be.

With such promising ground for development of a country-wide association of petroleum distributing interests, there seems to be considerable ground for the opinion that the British market holds every inducement to both nationals and independents to bury old prejudices and pull together.

▼

A.I.M.M.E. Concentrates on Oil Reserves

Various Methods of Estimating Oil Reserves, Mutual Obligations of Government and Oil Industry and Recent Engineering Practice, Covered at Annual Meeting in Houston, on October 10.

AT THE FALL meeting of the Petroleum Division of the American Institute of Mining and Metallurgical Engineers held in Houston on October 10–12, methods of estimating crude oil reserves were discussed in considerable detail, while other papers covered the relationship between the government and the oil industry and several other papers discussed some of the latest engineering practices.

The key-note of the meeting was the paper presented by Mr. M. Albertson, Research Engineer of the Shell Petroleum Corporation, who presented a paper entitled "Statement Relative to Estimation of Developed Petroleum Reserves." Mr. Albertson stated his problem as follows:

"The problem of securing more accurate estimates of developed petroleum reserves existed prior to curtailment of production. With curtailment, however, the problem became an acute one. Some of the more prominent reasons for the acute nature of the problem are as follows:

1. The standard method of estimation depended on production decline curves. This method is inapplicable while curtailment prevails and available methods are insufficient.
2. The retarding influence which wide open flow conditions imposed upon over-development is absent. Great losses of capital by over-development can now occur before realization of the true situation occurs, or before effective steps can be taken to stop

such wastage. This increases the need for early, accurate, estimates.

3. Above ground stocks have diminished and the equivalent of such supply tends more and more to be retained underground in the natural reservoirs. It becomes increasingly necessary to know accurately the amount of these stocks."

The above purpose is achieved at several stages of the development: with one or two wells drilled the estimation of reserves is qualitative; with some production having been secured from the field and with its approximate outlines known the estimation is semi-quantitative; and with the reservoir susceptible of accurate measurements the estimation is quantitative, in which stage the predictions of reserve should be within plus or minus 10 percent correct for the prevailing conditions.

Mr. Albertson lists all factors which influence recovery in an excellent summary:

A. Quantity of oil in the productive formation depends on:

1. Volume of the reservoir rock.
2. Porosity.
3. Saturation.

B. Energy available to move oil to the wells:

1. Energy of gas, oil, and water, due to pressure:
   a. Without expansion.
   b. By expansion of each fluid.
2. Energy of gravity acting directly.
3. Molecular energy of gas, oil, and water, to displace oil from reservoir rock.
4. Artificially supplied energy.

C. Loss of energy other than in moving of oil to the wells:

1. Escape of gas, oil, and water pressure without oil recovery.
2. Gravity may move oil from the wells as well as to them.
3. Escape of gas and water without exerting their molecular energy to move all.
4. Energy made unavailable due to loss of heat in reservoir, by solution reactions and changes of state.

D. Efficiency with which energy is consumed in movement of oil:

1. Well spacing.
2. Rate of oil recovery.
3. Permeability of sand. (Shooting, acid treatment, mudding of sand.)
4. Gas-oil ratio.
5. Water-oil ratio.
6. Locus of gas, water, and oil expansion.
7. Viscosity of oil.
8. Specific heat and latent heat.
9. Molecular energy.

E. Loss of oil and gas due to leakage:

1. Poor quality of casing.
2. Normal corrosion of casing.
3. Improper casing methods.
4. Entrance of surface water.

Mr. Albertson states that: "Enumeration of the factors and their classification into groups of factors is sufficient to suggest strongly that if accurate estimation of developed reserves has to await quantitative determination of all factors, it will never be possible. If this is true, hope of satisfactory estimates depends on finding the relationship between recovery and one or more groups of significant factors which may be readily determined. Below are some suggestions for exploration:

1. Fractional part of total energy consumed per unit of oil recovery.
2. Determination of oil recovery per unit retreat of oil from oil reservoir plus more accurate estimation of reservoir size and content. (Water surveys, gas surveys, electrical logging of formations, better core recovery, etc.)
3. Rate of reservoir pressure decline per unit of oil recovered, and influence of rate of recovery upon total recovery.
4. Oil recovery per A.P.I. gravity unit under reservoir conditions of temperature and pressure.
5. Average gas-oil ratio and rate of variation per suitable time unit for life of field.
6. Combinations of the above factors pertinent to the particular field."

Mr. Albertson completes his excellent summary by stating:

"Common effort is necessary to make the advances essential to solve field-wide problems and since specific problems whose answers are obtained without the effect of contributing factors being known are subject to grave error, it is imperative to have complete operator cooperation in collecting and analyzing data from any pool. Today, the engineer finds himself being challenged by the industry to advise it as to what path to follow in new development and it behooves the engineer to advise the industry fully what it must do to cooperate with him and permit him to arrive at sound conclusions. We must not permit our work to be classified as black magic or glorified guesses, but rather must we admit our shortcomings and intelligently attack the problems confronting us."

Mr. P. P. Gregory, Chief Petroleum Engineer of Yates Pool Advisory Committee, read a paper on Estimation of Petroleum Reserves in Prorated Limestone Fields, excellently summarizing this paper as follows:

"At this time no positive methods of estimation of petroleum reserves in prorated flush limestone fields are available owing to the peculiar character of the limestone reservoir, which lacks the relative uniformity of porosity and permeability found in sand fields. Predictions of per-acre recoveries in a new field based on recoveries obtained in "similar" older limestone fields may be highly erroneous.

"Experimental data indicate that:

1. In fields under volumetric control:

a. Coleman's formula may be used to obtain reliable estimates of the amount of oil originally present in the reservoir. The formula is also applicable for determination of recoverable oil, provided the average gas-oil ratio can be closely controlled.

b. Where such close control is lacking, the amount of recoverable oil can be estimated from the analysis of total recovery of fluids and corresponding decline in the average reservoir pressure.

2. In fields under hydraulic control:

Estimates of recoverable oil and of oil in place can be had from study of withdrawals made and of rise in oil-water contact, together with changes in extent of the gas cap."

Ralph Schilthuis, Research Engineer for the Humble Oil and Refining Company, presented a paper entitled Active Oil and Reservoir Energy, which went into considerable detail of the newer concept of the reservoir energy.

George H. Fancher and Kenneth B. Barnes discussed Water-Flooding in the Mid-Continent. The paper covered particularly eastern Kansas and northeastern Oklahoma in which area the writers estimate that there are 1,400,000 productive acres in the shallow fields which are open to water-flooding. By estimating this area to carry sands 20 ft. in thickness, of 15 percent porosity and with an oil saturation of 35 percent, the area is estimated to carry 8,000 bbl. of oil per acre.

"Consequently the oil content of the producing regions under 3,000 ft. in depth in Eastern Kansas is estimated at 4,800,000,000 bbl. and in Northeastern Oklahoma at 6,400,000,000 bbl. This considerable volume of oil remaining in the sands at the present time, properly speaking, is not a reserve. Only the recoverable portion is a reserve. If the whole acreage were found to be suitable for water-flooding by criteria discussed in this paper a reasonable recovery and, hence, a reserve, of 3,000,000,000 bbl. should be expected."

After considering in detail analysis of cores preliminary to water-flooding, production records, natural and controlled water-flooding and the physical and economic problems peculiar to the Mid-Continent, the authors conclude:

"To the casual observer of water-flooding in the East, the procedure and mechanics may appear relatively simple. Coring and core analysis may seem superfluous operations. However, contrary to the belief of many, a flood does not travel a uniform and fractional part of a foot per day in its progress through the sands. The unexpected can occur. In the East, for example, in extending a new line of five spot oil wells on a 400 ft. spacing, the operator of a certain project, to his surprise and embarrassment, obtained nine water wells. The flood had passed despite precautions. With Mid-Continent sands of higher average permeability, the danger of a similar occurrence is enhanced; valuable reserves can be lost permanently if water is introduced without definite

knowledge of the existing sand conditions.

Despite problems and difficulties, it is believed that a future awaits water-flooding in the Mid-Continent. This future depends on the solution of technical problems. If operations are conducted on a scientific basis and economic scale, the result should be that the interests of conservation will be served and the stripper well region will enjoy a prolonged economic life affording support to hundreds now dependent on the oil industries, values of stripper production will increase, capital will be attracted by dependable return on investments and a definite future to the Mid-Continent area can be planned and controlled. However, the process is no panacea for the economic ills of the region. Neither will it nor can it be relied upon to supply the oil required by the nation in increasing amounts. It cannot prevent inevitable shortage, but its use can be profitable and is essential from the standpoints of conservation and economics.

Alexander Deussen in a brief paper corrected the Acre-Foot Yields of Texas and Gulf Coast Oil Fields as given by L. P. Teas in Petroleum Development and Technology, 1934, A.I.M.M.E., pages 308–319. The figures arrived at by Mr. Teas were based upon, not the net thickness of producing sand formation, but "to the total of the net portion of the producing zones which actually yield oil into the drill hole." It is stated in Mr. Deussen's paper that in many instances only 20 or 10 ft. of screen might be set in the well when there might be actually 100 ft. of oil sand present. Further Mr. Deussen states that:

"A bed one foot thick and an acre in area contains 7,758 bbl. of sand. Sufficient tests have been made of the porosity of various sands from Gulf Coast fields to show that the average porosity of representative sands is not over 25 to 30 percent. If this entire pore space were filled with oil, it would only contain 1,939 and 2,327 bbl. of oil, respectively."

Thus, according to L. P. Teas, the acre-foot yield in Goose Creek field has been 1,778 bbl. and in Orange 2,599 bbl., while Mr. Deussen's investigations show that up to 1930 Goose Creek has produced 477 bbl. to the acre-foot and Orange has produced 767 bbl. to the acre-foot. It should be indicated that L. P. Teas' figures were based upon an out-dated method suggested by A.I.M.M.E.

Mr. D. L. Katz presented a paper entitled "A Method of Estimating Oil and Gas Reserves." While the method of estimating oil reserves as illustrated in this paper may undoubtedly prove to be of value, it is doubtful whether this method should be used alone. Most of the factors considered in Mr. Katz's paper were included in the generally accepted practices as illustrated by Mr. Albertson and, therefore, this method should be considered only as contributory to the complete study of the factors as tabulated by Mr. Albertson.

Mr. R. D. Parker, Chief Supervisor of the Oil and Gas Division of the Texas Railroad Commission since 1928, presented a paper entitled "Government and the Oil Industry—Their Mutual Obligations." After covering in considerable detail the subjects: Government in Business; Government Regulations of Business; Criticism of the National Recovery Program; The Waste of Natural Resources; Business Cycles and Their Effect upon the Oil Business; The State Compact of 1935; The Competitive Character of the Petroleum Industry, and discussing in some detail the Relationship Between Interstate and Intrastate Problems, as affecting railroads through the Federal Interstate Commerce Commission, which now exercises plenary powers within individual states, and comparing the I. C. C. and the possible situation that might arise in the producing branch of the oil industry as the result of the discovery of the Rodessa pool in Louisiana, bordering on Texas and Arkansas, the author concludes:

"The public welfare demands of the petroleum industry (a) that the needs of industry and commerce which lean heavily upon petroleum for their existence be served; (b) that a reserve of petroleum underground be protected and a dependable supply of petroleum products be available for national defense; (c) that the competitive system be maintained (on the basis of efficiency); (d) that free movement in commerce among the states of petroleum and its products be maintained to the extent necessary to supply the current needs and future supply of all the people of all of the states; (e) that the 'waste' of overproduction be stopped; (f) that the maximum and balanced yield of the several products of crude petroleum be realized in refining so as to avoid 'waste' (such for instance as preventing the use of the process of distillation of straight run gasoline where the residual oil is not further refined by cracking); (g) that such cooperative effort be made as is necessary with other industries to avoid recurring cycles of prosperity, panic and depression; (h) to sustain as nearly as may be possible employment at uniform level; and (i) that the industry meet government half way in an effort to perfect mutual benefits.

"Industry on the other hand in turn for the exactions of government has a right to demand (a) modification of the anti-trust laws which will sanction agreements in the industry to permit it more nearly to govern itself; (b) protection from over-production and 'waste'; (c) the nationalization of the principles of the Sharp Decision of the Texas Supreme Court in respect to the capture theory in controlled production; (d) embargoes on the movement of illegally produced oil in interstate commerce; (e) practically uniform laws in all states regulating the industry including the prevention of economic as well as actual waste; (f) the unbiased and efficient enforcement of all laws alike before all men; (g) standardization of inspection service on basis of knowledge of the business; (h) permission to maintain trade associations and meet upon grounds of common interest without fear of persecution under the anti-trust laws; (i) maintenance of property rights; (j) the right to unitize producing properties under fair basis of distribution of property yields and some satisfactory form of group control of marketing by the adoption of codes of fair practice and otherwise; (k) cooperative constructive attitude of government officials toward business; (l) revision of banking practices or some other governmental agency to restrict credit by means which will not break down a legitimate competitive system but will weed out the unfit; and (m) a proper balance of state and federal authority within the constitutional sphere of each so that each may supplement and aid the other cooperatively."

The papers dealing with the latest engineering practices included the Plug-Back Cementing Methods by C. P. Parsons, Vice President of the Halliburton Oil and Cementing Company, who discussed the most recent developments, including: "Balanced" Method of Plugging Back; Displacement Method; Plug Methods; Squeeze Jobs; Plugging Back in "Thirsty" Formations; and Plugging Back in Screens or Perforated Liners. Particular stress was laid on Plugging Back in "Thirsty" Formations, where three general methods are now being used: "One of them is to use regular cement slurry and make successive plug-back jobs by a displacement or other suitable method using a small amount of slurry in each job and allowing an interval of several hours between each job. Another method is to lighten the weight of the cement slurry by using a cement-bentonite mixture. The latest method, however, is to use a self-sealing cement, which contains a fibrous sealing material premixed with the cement in dry state at the cement plant. The idea of the latter material is that when the cement starts going out into the formation, the fibrous materials begin wadding up and building a seal against further entry of the cement slurry."

A paper on the Structure of Clay Gels was read by W. K. Lewis, of the Massachusetts Institute of Technology, in which the author discussed in great detail the mechanism of gelation which is of outstanding importance in the handling of drilling muds. The paper was presented as a result of exhaustive microscopic and ultramicroscopic laboratory studies.

J. C. Karcher, of the Geophysical Service, Inc., gave a brief summary of the most recent developments in "Electrical Logging of Formations Concurrent With Drilling," which, however, is still in experimental stage.

Other papers presented at the meeting covered: Acid Treatment; Insoluble Residue Methods and Their Application to Exploitation Problems; Use of Shot Perforation Methods, producing from bottom of reservoir by setting casing deep and subsequently retreating upward as the layers are exhausted; Mud Fluid Problems on the Gulf Coast; Experiments on the Vertical Flow of Gas-Liquid Mixtures and Subsurface Pressure Studies.

▼

Development of Mobile Rotary Rigs

WITH the greatly increased speed of rotary drilling the time occupied by rigging up and breaking down has gradually come to take more time in proportion to the overall time the rotary rig equipment is employed on individual locations. Thus in the East Texas field, where one week is sufficient for actual drilling, rigging up and breaking down time occupies around three days or almost half as much time as the actual drilling; while with heavier standard rotary rigs five days are necessary for rigging up and two days to break down. In solving the problem of the reduction of time of rotary rigs on any one location the most important factor has been the mobility of the machinery in its final assembly form on the derrick floor. In attempting to solve this problem many types were devised by a number of manufacturers within the last few years but to-date only a few have been successful in actual practice. One of the more efficient units now in actual and successful use in all of the Mid-Continent is the mobile rotary rig designed and developed by the Wilson Manufacturing Company of Wichita Falls, Texas, in cooperation with Helmerich and Payne, drilling contractors of Tulsa, Oklahoma. These two companies evolved an effective mobile rotary rig which successfully drills to around 4,500 ft. and may reach 5,000 ft. with actual operations in no way different from the standard type of rotary rigs, while the moving of these rigs from one location to another, rigging up and breaking down time, has been reduced from seven days to a few hours each. These mobile rigs have in recent months drilled over 500,000 ft. in Texas, Oklahoma and Kansas with good results in the speed of drilling and with very considerable savings in the cost of operations.

In designing mobile rigs the question of power is naturally a major consideration. The fuel for such equipment must be available easily and cheaply, moreover the use of natural gas is an important consideration inasmuch as in many oil fields natural gas is either the cheapest or an entirely free source of power. Therefore gasoline internal combustion engines have been chosen. The trucks used in the mobile type rigs are Internationals while the auxiliary engine is of similar size and design, both motors being equipped with interchangeable carburetors for the use of natural gas whenever available. The engines are 6-cylinder, valve-in-head type; N. A. C. C. rating 60 h. p.; maximum 140 h. p. at 2,100 r. p. m. The engines are water cooled and equipped with automatic starters. In actual drilling operations the two motors consume 220 gal. of gasoline daily, which at 18 cents per gallon figures at about $40 per day; the same engines using natural gas will burn 20,000 cu. ft. per day, with gas being furnished either entirely free or at around 20 cents per 1,000 cu. ft. or for $4.00 for the whole day's operations. Both engines together consume about 10 gal. of lubricating oil per week.

The main truck of the heavier type rig carries the two engines, the slush pumps and the draw-works. All this equipment is on a fixed frame and the truck is merely backed to the derrick and firmly anchored to the derrick frame and foundation. The truck chassis has a wheel base of 225 inches with an overall length of 342 inches. In addition to the main truck carrying the principal equipment, two medium size trucks are required to transport the rotary table, the crown block, the traveling block, hook, tool house and other routine equipment.

The more important features of this type of equipment are:

1. Connecting drive for the two engines, with truck motor normally operating slush pump, and the auxiliary motor driving draw-works and rotary table; both engines can be combined to obtain greater power for coming out of the hole, and in the event of failure of either engine the other can be used to drive both rotary table and slush pump, an important factor of substitute power not present in standard type steam rotary rigs.
2. The chain drive transmission has a wide range of speeds and in low gear can theoretically transmit 1,500 h. p. from both engines. The three lower speeds on the drum are transmitted by the jaw clutch while the three higher speeds are transmitted by means of a friction clutch mounted on the right hand end of the drum shaft.
3. The brakes are cam operated, fully equalized and self-energizing.

Obviously the mobile rigs are signally adapted to wildcatting where water supply is either limited or where water is unsuitable for use in the boilers, as well as to fast development campaigns in new oil fields where a drilling contractor with a number of wells to drill can operate with unusual economies, more particularly if natural gas is available for fuel.

▼

British Imports Expand

THE increase in total petroleum products imported into Great Britain during the first three quarters of 1935 is entirely accounted for by increased shipments of petrol which show an increase of 15.3 percent to the end of September.

British Oil Imports by Products

(Barrels)

	September 1935	9 months to Sept. 30 1935	9 months to Sept. 30 1934
Lamp oil	538,918	3,827,372	4,450,228
Motor spirit	3,003,510	27,906,600	24,204,257
Lubricating oil	169,369	2,135,851	2,301,971
Gas oil	370,145	2,273,972	2,913,884
Fuel oil	1,426,544	14,403,204	13,505,973
Other sorts	36,857	344,772	459,230
Total products	5,545,343	50,891,771	47,835,543
Crude	1,375,342	11,048,142	10,767,400
Total imports	6,920,685	61,939,913	58,602,943

▼

AN INTERESTING feature of the Port Jerome refinery of the Standard-Franco-Americaine de Raffinage is the 100 ton per day dewaxing unit designed by Separator-Nobel. This unit is capable of great flexibility being able to handle waxy oil of any crystalline structure. Wax can be removed before or after distillation or at any stage in the refining operation which may include solvent refining and acid treatment. Foster Wheeler, Ltd. have recently acquired the selling rights for this process in Europe.

Mangrove swamps after being cleared.

A finished road along the pipeline.

166 Mile Pipeline Through Indian Jungle

An Eight Inch Line Running from Tempino to Pladjoe in Netherland India, Belonging to Shell, Opens for Colonization a Hitherto Uninhabited Section.

THE oil fields of South Sumatra lie partly in the Palembang Residency and partly in the Djambi Residency. The crude oil is transported by pipelines to two refineries situated on the Moesi River near the town of Palembang. In addition to handling the crude oil from its own fields in the Palembang Residency, the Royal Dutch Shell Group's refinery at Pladjoe also handles that produced by the Nederlandsch-Indische Aardolie Maatschappij (N.I.A.M.), whose fields are situated in the Djambi Residency. The Government of the Netherland India and the Bataafsche Petroleum Maatschappij (belonging to the Royal Dutch Shell Group) each have a half interest in the N.I.A.M. From Pladjoe the products are conveyed by tanker to the various distributing centers, which are situated as far apart as Australia, South Africa and Japan.

The one previously existing pipeline from Djambi was connected with the pipeline system of the various Palembang fields, and the Djambi crude consequently had to be pumped over a total distance of 227 miles. Since its carrying capacity no longer met requirements it was decided at the end of October 1934 to lay a new line by a more direct route. This route, which passes through very difficult country, is 166 miles in length. An eight inch diameter pipe was decided on. To simplify transport in construction and to insure proper supervision a road was projected, running the length of the whole line, and this established a direct overland connection with Djambi, which could previously be reached only by sea.

Of the 166 miles from Pladjoe to Tempino, in Djambi, 67 miles could be laid along existing tracks. Through the remaining 99 miles a way had to be cut through highly irregular country covered in part with virgin forest, crossed by swamps and intersected here and there by numerous rivers. In order to limit the number of bridges the route was chosen which would follow what watersheds there were; and consequently only 19 bridges were required. In addition six river crossings had to be made with swings, having a total length of over two miles. For other water crossings upwards of 300 culverts with a total length of nearly two miles were made.

For the road a track was cut through the forest 164 ft. wide where the land was dry and 197 ft. wide in the swampy parts; these widths gave space for the construction of a road 20 ft. wide which is quickly drained after rain. To give some idea of the work involved, about 3,000,000 cubic meters of timber were felled and some 600,000 cubic meters of earth were

Applying Shell pipe asphalt on the Tempino-Pladjoe pipeline running through East Indian jungles.

moved for constructing dykes through the swamps, levelling the track, cutting through hills and filling up cuttings.

The wood cutting was done entirely by hand, coolies being specially enlisted for this work, but mechanical means, such as tractors, were used for uprooting stumps and for clearing the track made for the roadway, while mechanical rooters were also used to facilitate the removal of long roots by ploughing up the earth. Dynamite was used to remove the heavier tree stumps. Manual labor was employed only for earth work where mechanical power could not be used, such as in the construction of dykes in the swampy area; elsewhere good use was made of road graders and other road building machinery. The maximum allowable gradient of the road, bearing in mind the nature of the transport, was fixed at six percent, but in order to avoid undue constructional delay, this was not always held to in the more hilly districts, where for short distances gradients up to 10 percent occur. The illustrations give an idea of the terrain in this part of Sumatra and of the various stages in road construction.

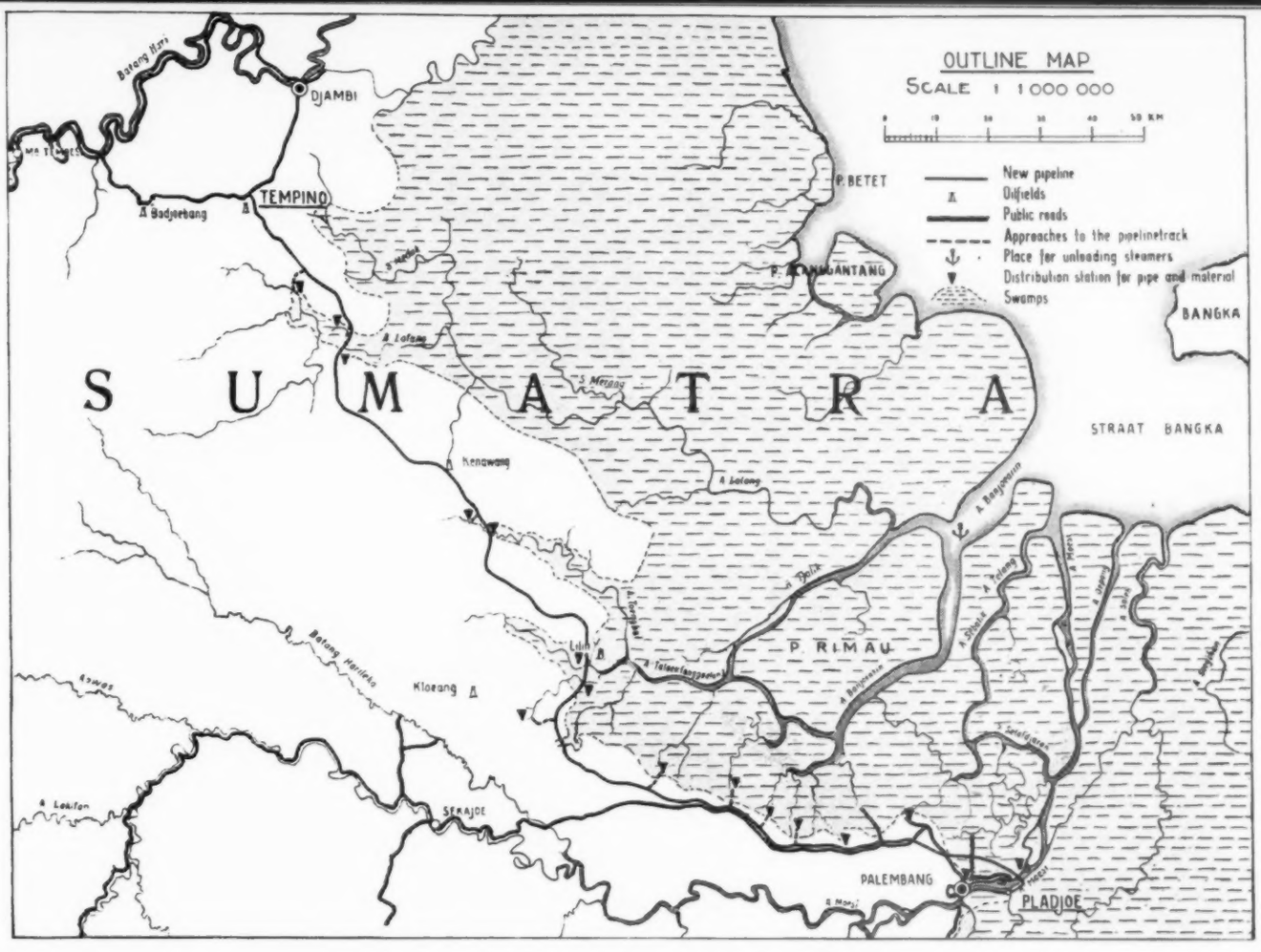
The progress of the work suffered from the heavy rainfall of the wet monsoon (October–April). At Pladjoe and Tempino there were 52 wet days in four months, with a total rainfall of 35 in. and 51 in. respectively. During the dry period the rainfall amounted to 3 in. and 4 in. per month respectively.

In the early stages of transportation of equipment and materials, use was first made of the rivers crossing or closely approaching the projected route of the pipeline. For the 99 miles of new track passing through the forest these rivers are the Aer Soepad, the Aer Dawas, the Aer Toengkal and the Aer Lalang, which, as can be seen from the map, all flow into the Aer Banjoeasin or into its tributaries, as is also the case with the small rivers near the 67 mile track along the road already constructed west of Pladjoe.

It was arranged that the consignments of pipes should not be unloaded at the usual ports of Pladjoe or Palembang, but that a landing place should be chosen in the deep and broad Banjoeasin River, by which a saving of 46 percent of the ton-mile water transport costs (calculated from Pladjoe) could be effected. The cargoes of piping were transshipped into shallow draft lighters, which were then towed to the various distributing centers up the various rivers. Altogether 20 discharging berths were constructed which were connected to the pipeline route by roads which had to be newly built in some sections.

At the Banjoeasin River unloading center, pipeline consignments of 15 miles length and approximately 1100 tons weight were transferred from ocean liner to lighter in 48 hours. Other less bulky materials were unloaded at Pladjoe and forwarded from there by river transport to their destinations.

The pipes and other materials were transported from the landing places on or near the route by mechanical means (trucks or tractors) to where they were required, but land transport, which is, of course, more expensive than water trans-



Map showing the route of the Tempino-Pladjoe pipeline running through swamps and jungles in Netherland India.

port, accounted for but 7.4 percent of the total.

The seamless steel pipes used have an average length of 37 ft., an inside diameter of eight inches and a wall thickness of 0.33 inches. In order to insure a permanent weld the pipes have billed ends, which allow for the insertion of a chill ring. The intervening space between pipes and chill ring was filled in by electric welding giving a weld of 100 percent strength.

The pipes were tested to 90 atm. pressure. Altogether 23,736 pipes were delivered having a total length of 166 miles and a weight of 12,909 tons.

In organizing the welding gangs it was possible to apply the experience gained during the construction of the pipeline of the Iraq Petroleum Company. The construction crews were originally composed as follows:

(1) The transport gang, employed for the conveyance of the pipes from the supply depots and for laying them along the route already prepared. This transport was effected mostly by means of trucks, but tractors were employed in places where the road was still in a poor condition.

(2) The line-up gang, whose function is to lay the pipes in straight sections on dollies, to decide the length of the sections and to fit in the backing-up rings. In order to minimize bell-hole welding it was naturally desirable to make the sections as long as possible. This, however, was dependent on the nature of the ground; in undulating parts or at curves there are sections of only a few pipe-lengths, while along a straight route a maximum of 27 lengths (984 ft.) have been joined to form one section.

(3) The spot welder provisionally joins the pipes in a section by welding at two or three points of the circumference.

(4) The fire-line or roll-weld gang welds a number of joints into a pre-determined section. A few months' experience showed that the spot welder and roll weld gangs could be combined.

(5) The tying-up and bell-hole gang connects the section welded by the fire-line gang with the pipeline already laid. The section is laid at the correct place with the aid of tractors and bent where required, this being done cold and with two tractors. The average length of a section is about 10 pipe-lengths, involving one bell-hole to every nine fire-line welds.

Bell hole welding on the 8 in. line on a section where the road parallels the pipeline.

An average of 20 fire-line welds per working day was obtained from European and native welders together, while a European welder attained a maximum number of 40.

The bell-hole welding was at first given to three American welders transferred from the Iraq Petroleum Co. A maximum of 20 bell-hole welds per day could be made by one welder.

The piping is thoroughly cleaned with pipe cleaning machines. Shell products were exclusively employed for the preservation work. Where the pipeline had to

A temporary native camp in forest clearing.

be laid in dry ground a thin cutback coat and then a three mm. (0.12 in.) coat of Shell Pipe Asphalt sufficed, whereas in swampy stretches and at road crossings the pipe thus treated was additionally wrapped in cocoanut cloth upon which a second coat of Shell Pipe Asphalt was applied.

For protecting the swings through the rivers the following products were applied in the order given:

Cut back coat, Shell Pipe Asphalt, Coir wrapping, Shell Pipe Asphalt and a casing of damp-resisting wooden laths further protected by Wonokromo asphalt.

After the necessary cleaning and coating the pipeline is entrenched at a depth of about 28 in.

Previous to protecting any one section of the line it was carefully tested for tightness, since even a small leakage, insignificant from the point of view of oil loss, would damage the protecting asphalt coating and corrosion would set in.

The line was submitted to a water pressure of 90 atm. (about 1½ times the maximum working pressure) and examined by inspectors not connected with any of the welding gangs. Random hammer tests were also made to test the tightness of the weld. All welds passed the strength test excellently, while the thorough inspection for tightness brought to light only a small number of sweating or weeping welds, which were caulked or, to be on the safe side, rewelded. The pressure test for the first 99 miles, which was effected in stages, showed the number of leakages to be one per thousand, while still better results were obtained when testing the remaining sections. Consequently the quality of the 23,700 welds, including 2,300 bell-hole welds, can be regarded as satisfactory.

A measure that, it is believed, favorably influenced the quality of the welding was the introduction of individual die stamps. Each welder has his own mark and was compelled to stamp this close to each weld completed by him, so that should any leakage occur during the pressure test, it could be immediately ascertained who was responsible for the weld in question. A spirit of friendly rivalry was thereby created and at the same time the quality of the work did not suffer as a consequence of the number of welds completed per day.

At six places swings had to be made for large river crossings, and of these four were constructed as double swings and two (running parallel to swings already existing) as single ones. The largest is that over the Moesi, with a length of 3936 ft. The swing was welded in its entirety on land, protected in the manner already described and laid on light four-wheel trucks on a rail track. At the same time at every 82 ft. along its length oil drums were attached to the piping in order to keep it afloat. Any grating of the line pipe over the river bed with the resultant damage to its lagging was thus

Forty foot steel tractor-carrying bridge in the South Sumatra jungle. The pipeline may be seen in the foreground.

avoided. The swing was then drawn across by tugs and landed on the farther side by winch tractor. When the entire swing had been drawn across and stretched, the drums were loosed off from the line which was allowed to sink to the bed of the river.

As far as possible the lines were swung at ebb tide; the influence of the tide in the Bangka Straits comes up more than 62 miles inland owing to the back-flow of the river water. The line pipe used specially for swings was sent out after having been pickled with phosphoric acid at the factory and afterwards protected with a Shell priming coat.

After the Board of Directors of the N.I.A.M. had decided on October 31, 1934 to lay the pipeline, the organization of the work was immediately begun, and by the first week of November preparations for the route had started.

On November 20th tree-felling was started at two points and in December work was progressing from six points. By August 31, 1935 felling was completed, the maximum progress for one month being 15 miles.

The earth work was begun on a small scale in December, 1934, and continued at full pressure during March when the felling was sufficiently advanced and the mechanical power in the meantime had arrived.

The construction and placing of bridges and culverts kept pace with the progress of the earth work, which was ready by the end of September 1935. The maximum progress for one month in this was 29 miles.

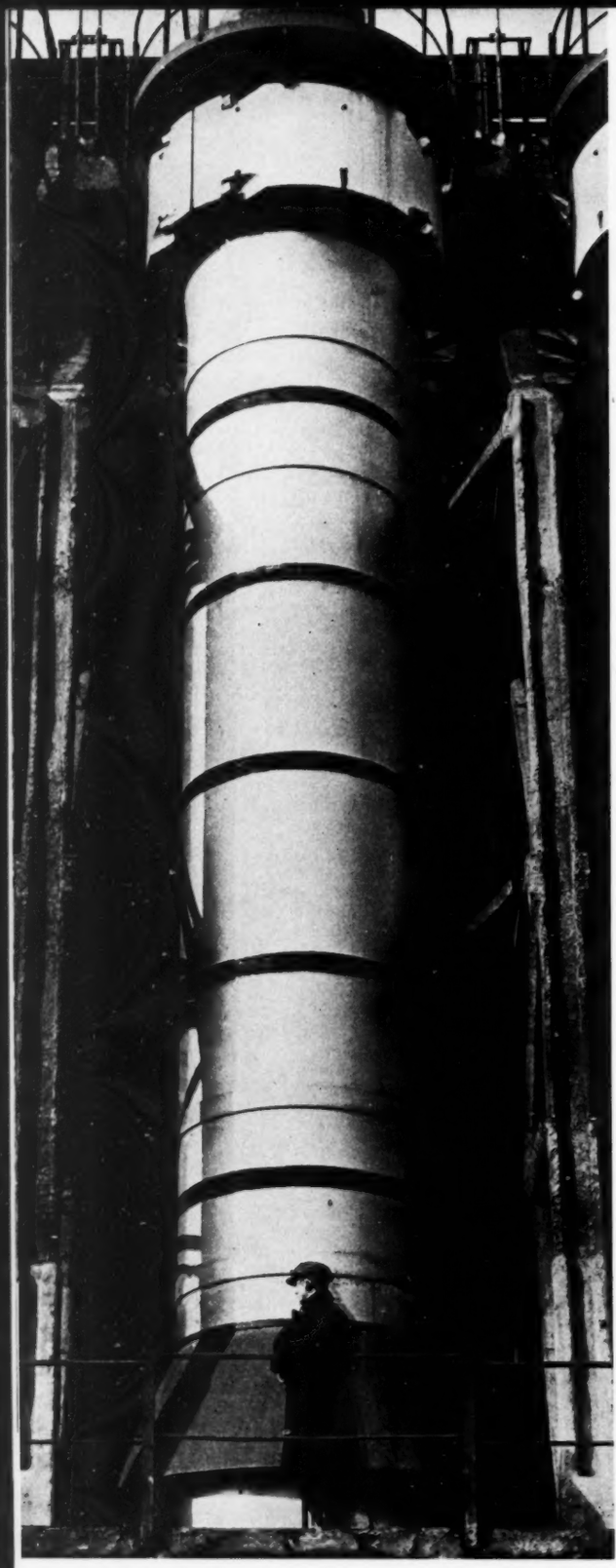
A start was made with the welding work on December 11, 1934. At the beginning of October, 1935, the pipeline was welded in its entirety and by the middle of the same month, after the last swing has been drawn, it will be ready for pumping. As regards welding, a maximum of 20 miles per month was done during the first eight months of 1935 using 12 welding machines.

It can fortunately be said that the health of the Europeans and natives engaged in the pipeline work has been in general very satisfactory, as is proved by a sickness figure of two percent. The medical service of the company has taken precautionary measures to prevent as far as possible the outbreak of such tropical diseases as dysentery and malaria in this unhealthy and partly swampy district, and considerable care was also taken to insure living conditions for Europeans and natives being as good as possible. A separate medical service, organized to deal with sickness or accidents, accompanied the various working parties as the work progressed.

Food supplies were organized entirely from Pladjoe in conjunction with the Employees' Cooperative Society there, which established a temporary depot at each of the outposts. Free provisions were distributed to the natives employed, a factor that undoubtedly contributed in keeping sickness at a minimum.

By the time this article appears the pipeline connecting the Residencies of Djambi and Palembang will already be in use. Thus not only will a new oil transport route and direct communication have been established, but the petroleum industry has at the same time been instrumental in opening up for colonization a hitherto uninhabited tract of land.

Floating a river swing with barrels showing native huts and the dense jungle across the river.



Converters—one of the three high pressure vessels where the coal is actually hydrogenated at the Billingham-on-Tees plant of the Imperial Chemical Industries, Ltd., in England.

▼

World's First Plant for Hydro Opened in England

Attended by Distinguished Guests, The Imperial Chemical Industries Plant at Billingham Opened Formally on October 15 as Result of Combined Efforts of Government and Industry.

OPENING of the Billingham bituminous coal hydrogenation plant on October 15th by Mr. Ramsay MacDonald marks the outstanding industrial event that has taken place in recent years in the United Kingdom. The conversion of bituminous coal, a national raw material, into liquid fuels takes the aspects of a completely new British industry and as such it bids fair to be of far reaching importance both in the national and industrial life of the Empire.

Before a gathering of distinguished guests, which included Miss Ishbel MacDonald and Lady McGowan, the Belgian Ambassador, the Chilean Ambassador, the High Commissioner for Canada, Dr. F. T. Cheng, their Worships the Mayors of Middlesbrough, Stockton and Thornaby, Prof. F. K. R. Bergius, inventor of the hydrogenation process, Dr. C. Krauch, Dr. M. Pier, Sir Henry Deterding, Dr. J. B. Aug. Kessler, Sir Harry McGowan and many other noted representatives, official opening and dedicatory exercises took place.

The carrying out of this immense project was made possible only through the cooperation of the national government and the Imperial Chemical Industries Limited. The event is of special significance because it marks both the commercial application of this great technical achievement and the successful cooperation of an outstanding industrial organization and the national government in the exploitation of an important natural resource.

The hydrogenation process, by which coal is converted into a liquid fuel originated with Dr. Friedrich Bergius and as early as 1910 research and technical work on this process had already begun. The scientific background of hydrogenation of coal is of fascinating interest and a brief summary will permit a better appreciation of the foundation and development of the process.

Dr. Bergius, as originator of the process was first prompted to study the hydrogenation reaction while considering the difficulties encountered in cracking oil and residues for conversion into gasoline. While studying the cracking process, which in 1910 had hardly been developed, and considering the high gas losses, the unsaturated character of the product, and the coke formation which resulted, he was led to the conclusion that the addition of hydrogen would overcome these difficulties. His investigations confirmed the correctness of his assumptions.

Subsequently in 1911 he observed that when treating peat in the presence of liquid water at temperatures of more than 300 deg. C. considerable amounts of carbonic acid were produced during this process and the composition of the powdery residue formed was very nearly that of natural bituminous coal. This observation suggested a closer study of the process of decomposition of vegetable substances which might undergo a transformation similar to that which occurs in nature during the course of millions of years in their gradual transition into coal.

Dr. Bergius' astute scientific reflections proved that the main part of the vegetable substance—the cellulose—which is formed through the influence of sun energy, is, from a thermodynamical point of view, an unstable product. Moreover, he observed that this unstable product at normal temperatures decomposes so slowly that the decomposition speed escapes observation.

Later he carried through, extensive and systematic trials on the decomposition of cellulose of wood and other vegetable substances at temperatures between 290 deg. C. and 350 deg. C. in the presence of

genation of Bituminous Coal

water under pressures exceeding 200 atm. (3,000 lbs. per square inch). The treatment of cellulose, as well as lignine lead practically to the same coal-like final substance. This process of transforming cellulose into coal led to the liquefaction of coal by hydrogenation.

Up to that time coal was considered solely as carbon whereas these investigations and hypothetical assumptions suggested that coal is a combination of carbon, hydrogen and oxygen and that the character of this compound would permit ready chemical absorption of hydrogen with the subsequent yield of a heavy petroleum-like substance.

With such comprehension of the problem and penetrating reasoning Dr. Bergius was prompted to add hydrogen to coal to note the effect. Experiments conducted under 150 atm. and from 400 deg. to 450 deg. C. resulted in 80 percent conversion of the coal into gaseous, liquid and other products soluble in benzol. These investigations and results form the foundations for the present hydrogenation process which transforms bituminous coal into motor fuel.

It was not until 1921 however that Dr. Bergius had the opportunity to reveal the outcome of his investigations and to outline his ideas to the Department of Scientific and Industrial Research and through his influence, later in 1923, experiments were initiated by the British government's Fuel Research Station.

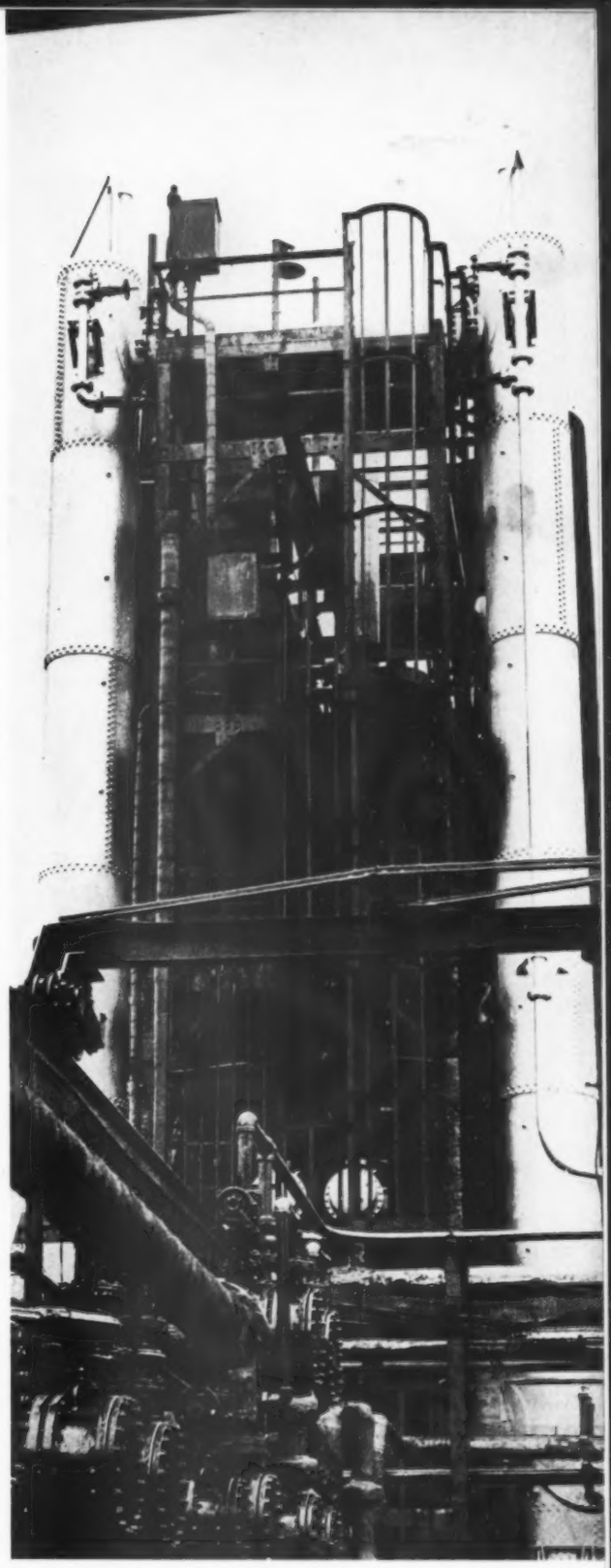
In 1927 the interest and vision of Sir Alfred Mond resulted in the national government subsidizing further research and assigning the prosecution of this work to the Imperial Chemical Industries, Limited. At this juncture Sir Alfred Mond, in recognition of the government's aid, wrote to Lord Balfour, "I should like to put on record my view that I consider the monetary assistance given by the British Government to the Syndicate has been a most important factor, probably an all important factor, in preserving for this country and the Empire an interest in what may turn out to be a highly important industry." This great industrial leader little dreamed of an early favorable outcome of his efforts.

The realization of the present undertaking represents the overcoming of great financial and technical obstacles by perseverance, vision and an undaunted spirit that certainly could not acknowledge defeat. In 1927 small scale experiments were started. For two and a half years research continued on a moderate scale. In 1930 and 1931 notwithstanding the worldwide economic crisis, there was launched an extended research program which included a pilot plant for the treatment of 15 tons of coal per day.

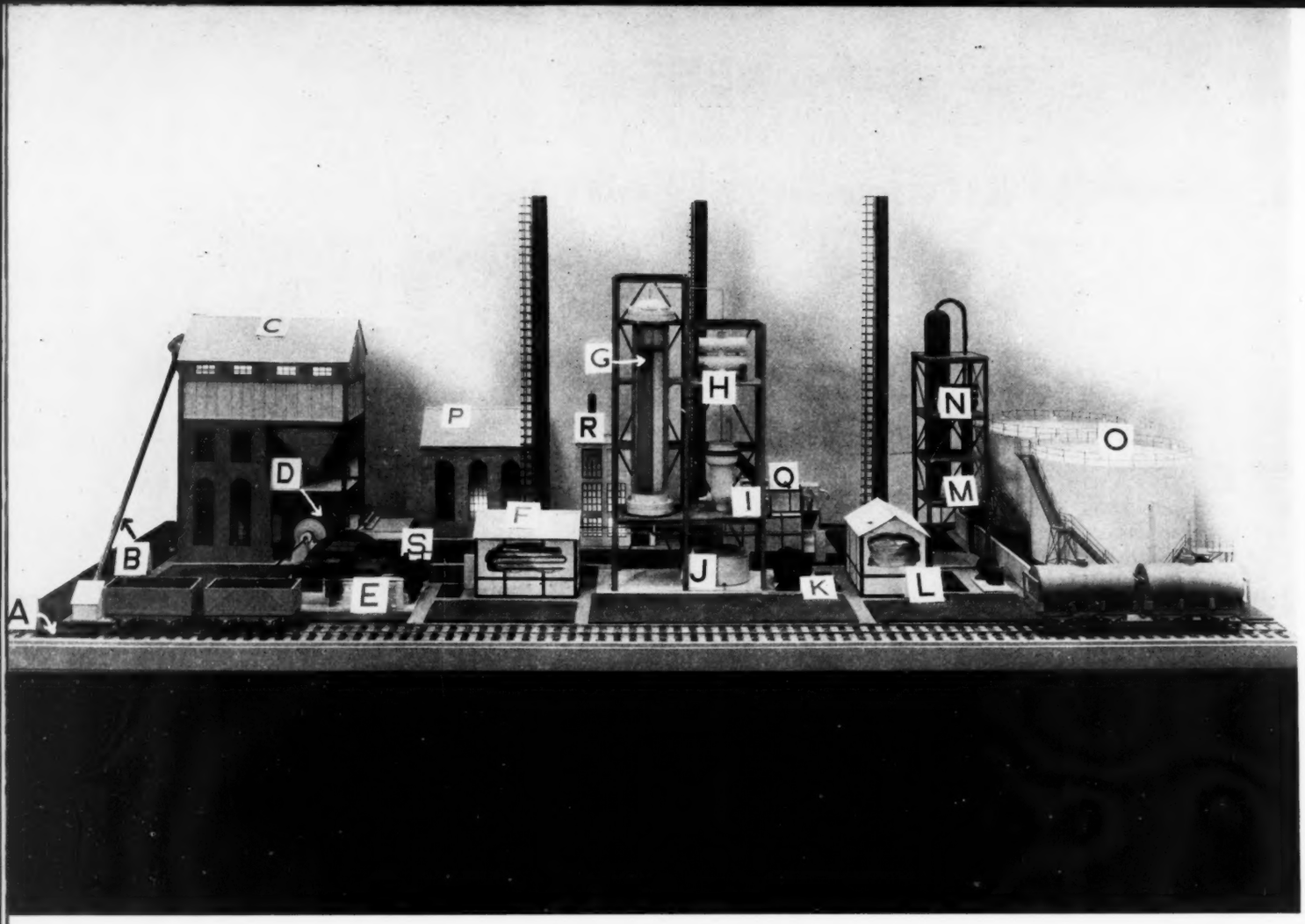
Fruitful results from this research program were not anticipated before the lapse of many years and the past eight years of investigation has led to the expenditure of more than £1,000,000.

During this time similar activities had been progressing in the laboratories of the German I.G., the Standard Oil Company of New Jersey and of the Royal Dutch Shell group and international cooperation among these companies in the development of this process was brought about. In 1931 a pooling of interests in the hydrogenation process, including a provision for a complete exchange of information among these companies, led to more rapid progress through exchange of experience and ideas and immediate contact with other major developments in this field. At this time arrangements were made to market the products of the hydrogenation process through existing petroleum marketing companies thus obtaining cooperation from what would seem a possible competitor and relieving this new industry of an added investment in duplicating distributing facilities.

The intensive research and the added international cooperation brought about very encouraging results and through the Fuel Research Board who visited the experimental plant and to whom all the details of the work were disclosed, the British Government was informed of the technical progress that had been attained. The assurances of this commission confirmed the claims of the investigators and although the scientific aspects of this remarkable development were most promising, the economic aspects presented obstacles of a nature that science alone certainly could not surmount. The national government again played a major rôle. On July 17, 1935 Mr. Ramsay MacDonald announced in the House of Com-



Distillation section of the hydrogenation plant which was completed with the aid of the government and formally opened on October 15. Note the size of the man in the crow's nest atop the plant.



Model showing typical features of a hydrogenation plant. This is not a model of the Billingham plant, having but one reaction chamber, where the actual plant has three.

mons the policy of the government toward this new development. In March 1934 Parliament passed the British Hydrocarbon Oils Production Bill whereby it guaranteed a preference to all British-produced motor spirit. The act provided for a maximum subsidy of 8d. per gallon for a period of four and one half years from April 1935 and if the preference drops to the guaranteed minimum of 4d. per gallon the period is extended to nine years. An intermediate preference results in a proportionate time period.

The immediate effect of this government declaration was the announcement by the energetic Sir Harry McGowan that the Imperial Chemical Industries, Limited would proceed at once to erect a commercial scale plant for the hydrogenation of bituminous coal. Construction was therefore authorized, which started August 1933, and within about 18 months the plant was completed.

Original plans called for the production of 100,000 tons of petrol from coal. It was decided later, however, to increase the proposed capacity to 150,000 tons of motor fuel per year. The added 50,000 tons to be produced from coal or creosote oil and low temperature carbonization tar. The first unit was ready for operation in January 1935 which was designed for the processing of creosote oil. The unit for the treatment of coal was put into operation June 1935. The normal capacity of the plant is 410 tons of petrol output per day or about 3,400 U. S. barrels of gasoline. To date 11,000 tons of coal have been converted into liquid fuel and the total amount of petrol that has been produced from processing creosote oil and low temperature tar, and the above, amounts to 40,000 tons. Full capacity of the installation is expected to be realized before the end of the year.

For the manufacture of 100,000 tons of motor fuel per year by the hydrogenation of coal and 50,000 tons by the treatment of creosote oils and low temperature tar, 600,000 tons of coal are consumed per year. In addition to this 750,000 tons of coal for other purposes than the manufacture of petrol are required. This makes a total of 1,350,000 tons of coal per year or about 4,000 tons per day. These proportions are equivalent to four tons of coal to one ton of motor fuel or about 8.6 U. S. barrels of gasoline and an overall ratio of about 9 tons of coal to 8.6 U. S. barrels of motor fuel. The total output of this plant will represent about four percent of the national consumption.

This plant commands great scientific interest inasmuch as it is the first installation in the world designed for the hydrogenation of bituminous coal. For some years past the treatment of brown coal for motor fuel production has been carried out in Germany at the Leuna works of the I.G. where by hydrogenation some 300,000 tons of gasoline are produced annually. In the United States a unit of this process operated by the Standard Oil Company treats 5,000 bbl. per day of charging stock and its operation has been confined to the hydrogenation of heavy petroleum, principally for the production of high quality lubricants.

The accompanying illustration of a small model of the plant shows admirably the various steps of the process as practiced at Billingham. A brief description of the essential steps is as follows:

Clean coal with less than 2½ percent of ash is fed into the hopper (A) and taken by conveyor (B) to storage bunkers (C). The coal is then fed to the grinding mills (D), where it is mixed with heavy oil, returned [along pipe (S)] from a subsequent operation, and the whole ground into a fine paste consisting of 50 percent coal and 50 percent oil. High pressure paste injectors, (E), force this paste against a prevailing pressure of 3,700 lbs. per square inch (250 atm.) into the converter system. Only one converter is illustrated here but three are actually used, in series. At this point it joins the hydrogen, which has been manufactured in plant (P), by passing steam through an incandescent bed of coke and an added amount also is obtained by passing a carbon monoxide steam mixture over a catalyst. This auxiliary process yields hydrogen, carbon monoxide and dioxide. The monoxide is returned and the carbon dioxide is compressed and disposed of as "Drikold", a solid refrigerant which is finding wide application.

The paste and hydrogen mixture are preheated to the decomposition and liquefaction temperature of 450 deg. C. at (F). The charge then passes to the converters (G) where the reaction takes place. These are specially constructed heavy forgings made of alloy steel to contend both with the high pressures, temperatures and corrosive action of sulfur and hydrogen compounds. Most of the products and gas pass overhead from the converters through a cooler (H) to a catchpot (I) where the condensed mixed oils separate from the non-condensable gases. The former are collected in a tank (J) and pumped (K) to a distillation unit where they are heated in the furnace (L), and fractionated in the column (M). Petrol is distilled off, condensed and cooled, (N), and after a very slight refining treatment which consists of a light caustic wash, it is stored in tanks (O) ready for shipment by tankers or by rail.

The heavy fractions (S) are returned to the process, part being used as pasting oil in the coal mills (D), and the remainder hydrogenated in a separate unit so that only motor fuel is finally produced. Referring to the converter (G), a heavy residual sludge including all the coal ash amounting to about five percent by weight, is purged off the bottom of the system and passed to a sludge plant (R), where as much oil is recovered as possible and remainder made into solid fuel for burning in the heaters.

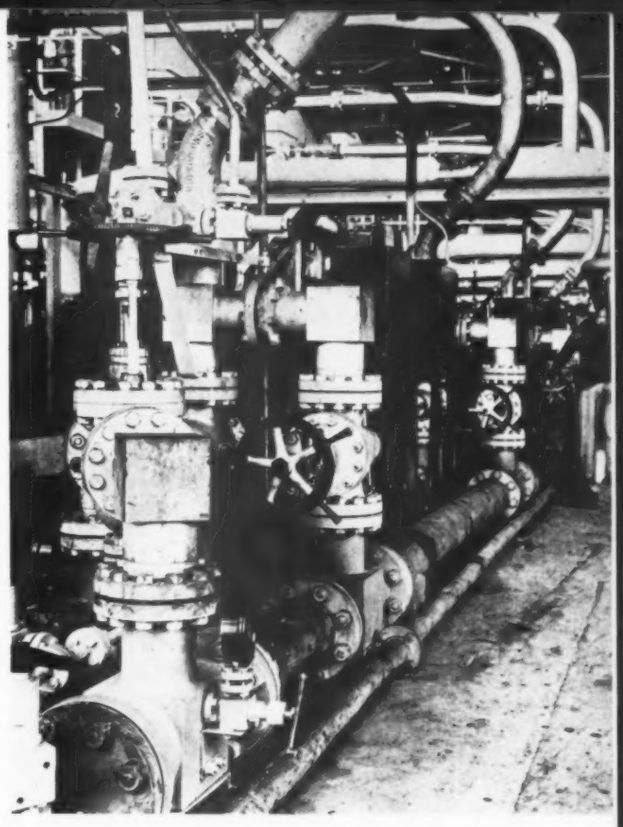
The uncondensed gases separated in the catchpot vessel, (I), are treated to recover all the available hydrogen and the balance, consisting chiefly of hydrocarbon gas, is returned to the hydrogen plant (P) as a source of further hydrogen for use in the process.

The raw materials for this process are essentially coal and water. The flexibility of the hydrogenation process permits convenient treatment of either coal, creosote oils or tar and likewise results in a variation of products according to the conditions arranged. The yields may be fuel oil, Diesel oil, kerosene, gasoline, liquefiable gases such as butane and propane.

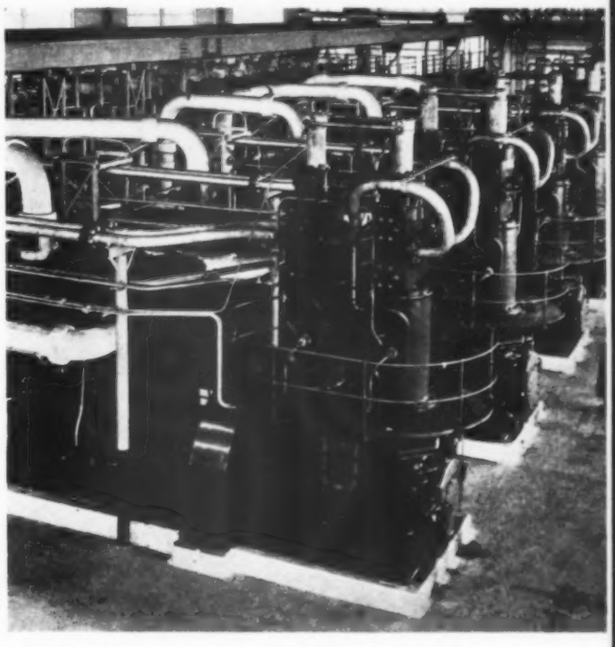
Coal may be transformed almost quantitatively into petrol, the yield varying between 60 percent and 70 percent by weight. Low temperature tars and creosote oils can be hydrogenated into petrol with a yield of 80 percent to 90 percent by weight. In addition to these 5 percent of water and some 20 percent to 7 percent of gas and a hydrogen absorption of 4.5 percent to 6.0 percent by weight are obtained.

As a home industry the installation of this process opens opportunities for employment. The total number of employees at Billingham rose from 7,000 to a peak of 13,000 during the construction work. Capital expenditures amounted to £3,000,000 which corresponds to the employment of 9,000 men for eighteen months. Of the 9,500 workmen now in normal employment at Billingham, about 2,000 are engaged in the manufacturing process, in the necessary manufacturing services required and in the research divisions. In addition, the extra coal consumption corresponds to the employment of 2,000 miners.

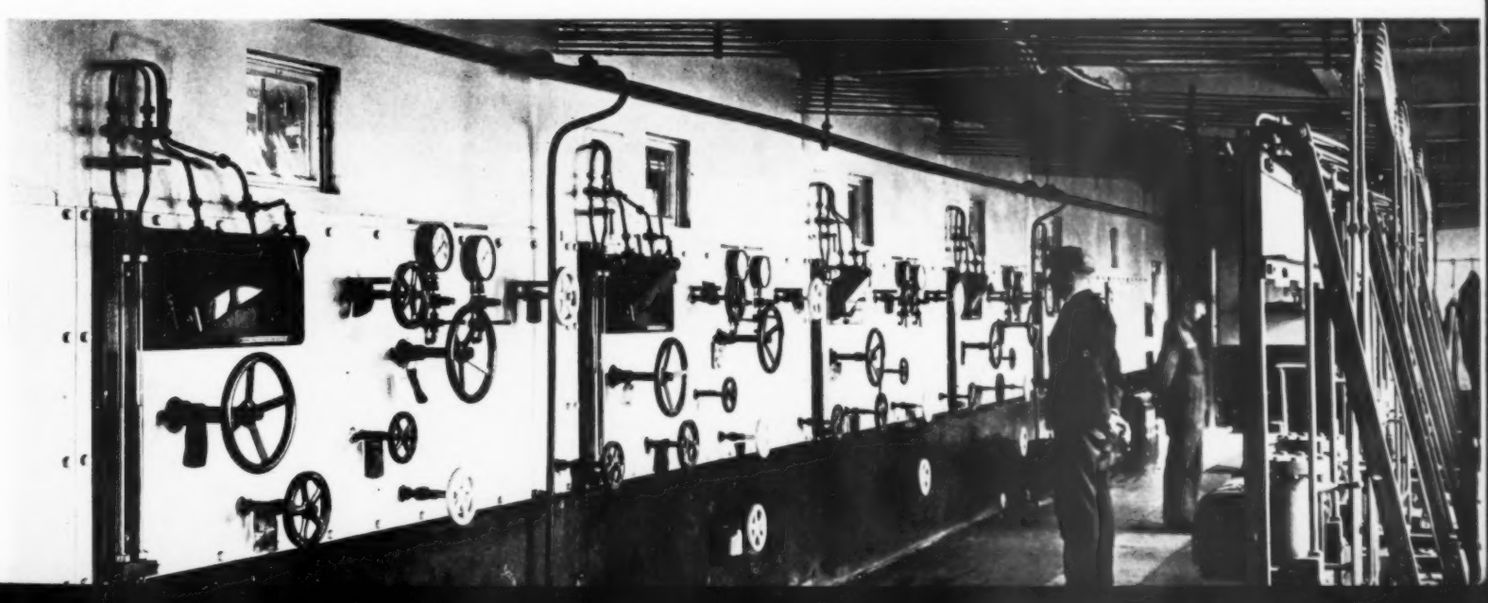
E. Ospina-Racines



Above: Pipes and valves associated with the injection of coal paste.



Above: High pressure machines for circulating the hydrogen gas.



In these quiet rooms the behavior of the entire plant is recorded on instruments.

Foreign Oil Legion

LAURENCE WOOD ROBERT, assistant secretary of the British Treasury on 11th October married Evelyn Walker, daughter of the late Harold Walker, former president of the Standard-Vacuum Oil Company.

RYLAND BENJAMIN ANDREWS, who recently was appointed general manager of Romano-Americana at Bucharest, in place of J. Hughes, retired, is an American and has been in the oil business since 1912 when he was associated with the Prairie Oil and Gas Company at Tulsa. Early in 1914 he was given his first assignment by Romano-Americana, namely as efficiency expert on the Moreni field, later being made assistant superintendent at Baicoi. During the first part of the war Mr. Andrews was stationed in Cuba and Florida for the Jersey Standard; but in 1917 went to Bucharest as assistant military attaché with the rank of Captain. After the war he returned to Romano-Americana as purchasing agent, and in 1925 was made export and domestic sales manager.

R. B. Andrews (Right) and J. Hughes

M. R. BRIDGEMAN, New York representative of the Anglo-Iranian Oil Company, Ltd., returned to the United States from London on the North German Lloyd liner, Bremen, sailing from Southampton on September 28. Mr. Bridgeman was accompanied by his wife. Anglo-Iranian

M. R. Bridgeman

offices in New York are located in the British Empire building of the Radio City group facing on Fifth Avenue.

JOHN PRIMROSE, who has been Vice President of the Foster Wheeler Corporation since it was organized, has been elected to the office of Vice Chairman of the Board, following the resignation of Mr. Pell W. Foster, who will continue as a director. In 1902 Mr. Primrose became Chief Engineer of the Power Specialty Company and subsequently Vice President in charge of oil refinery activities. When the Foster Wheeler Corporation was formed, Mr. Primrose was elected a Vice President, which office he has held to the present. Through these associations he has become well known in the oil refining industry in this country and abroad.

John Primrose

W. S. DOYLE, representative of the Royal Dutch-Shell group in Caracas, Venezuela, namely—the Caribbean Petroleum Co., the Venezuelan Oil Concessions, the Colon Petroleum Corporation and the Petroleum Utensils Company—is visiting the United States following a visit to London, and will shortly be back in his office at Caracas. Mr. Doyle has been handling oil affairs in Venezuela for about 23 years.

DR. PER K. FROLICH, formerly director of the Esso Laboratories, has now been made Chief Chemist of the Standard Oil Development Company. In this capacity he will contact the various laboratories of the company, both here and abroad, serving as an adviser in technical and patent matters. He is succeeded as director of the Esso Laboratories, one of the research units of the Standard Oil Development Company, by G. H. B. Davis, formerly assistant director. H. W. Fisher becomes the new assistant director. Dr. Frolich will continue to make his headquarters at the Standard Oil Development offices in Bayway, N. J. Dr. Frolich was born June 29, 1899 at Kriskiammand, Norway and graduated from the Norwegian Institute of Technology in 1921. During 1922 and 1923 he was a Fellow of the American-Scandinavian Foundation working at the Massachusetts Institute of Technology and until 1929 was associated with M.I.T. as assistant professor of engineering chemistry. In 1929 Dr. Frolich joined the Standard Oil Development Company and started work on high pressure reaction studies, for which he later received the Graselli Medal.

Gulf Export Prices for Major Oil Products

	Products	Cents per Gallon			
		Sept. 24	Oct. 2	Oct. 9	Oct. 15
Gasoline:	U. S. Motor	4⅝	4½	4⅝	5
	64/66–375 E. P.	4⅞	4⅞	4⅞	5⅛
	59 Oct. & below	5¼	5¼	5¼	5¼
	65 Oct. & above	5½	5½	5½	5½
Aviation Gasoline:	73 Oct. & above	9½	9½	9½	9½
Kerosene:	44 w.w.	4¼	4¼	4¼	4¼
	41–43 w.w.	3⅞	3⅞	3⅞	3⅞
	41–43 p.w.	3⅞	3⅞	3⅞	3⅞
Gasoil:	26–30 translusc.	3⅛	3⅛	3⅛	3⅛
	30 plus translusc.	3⅛	3⅛	3⅛	3⅛
Fuel Oil:	Bunker purposes (per bbl.)	$ .80	$ .80	$ .80	$ .80
Grade C:	Cargo lots (per bbl.)	$ .70	$ .70	$ .70	$ .70
	Diesel oil (per bbl.)	$1.50	$1.50	$1.50	$1.50
Lubricating Oil:	Bright Stock No. 8	24½	25	25	25½
(New York Export	Bright Stock No. 6½	24	24½	24½	25
Market)	Warren E.	20	20	20	20
	600 Unfilt.	16½	16½	16½	16½
	650 Unfilt.	18	18	18	18
	600 Flash s.r.	19	19	19	19
	630 Flash s.r.	24	24	24	24
	Neutral 200 No. 3	28	28½	28½	29
	Neutral 150 No. 3½	23	23½	23½	24
So. Texas:	Red oil 300 No. 5–6	6¾	6¾	6¾	6¾
	500	7¼	7¼	7¼	7¼
	715	9	9	9	9
	1200	9½	9½	9½	9½
	Pale oil 300	7	7	7	7
	500	7⅞	7⅞	7⅞	7⅞
	750	9	9	9	9
	1200	9½	9½	9½	9½
Crude Oil:	East Texas crude delivered at Gulf port for Export	$1.17	$1.17	$1.17	$1.17
	Venezuela crude	.83	.83	.83	.83
	Trinidad crude	.85	.85	.85	.85
	Panuco crude	.87	.87	.87	.87

UNITED STATES

	Daily Crude Oil Production bbl.	Daily Runs to Stills bbl.	Total Motor Fuel Stocks bbl.	Imports for week bbl.	California Shipments East for week bbl.
Week ending Sept. 14	2,786,000 482,500*	2,690,000	54,221,000	984,000**	240,000
Week ending Sept. 21	2,811,500 484,000*	2,820,000	53,881,000	683,000**	179,000
Week ending Sept. 28	2,796,500 481,000*	2,795,000	54,216,000	1,101,000**	201,000
Week ending Oct. 5	2,760,500 473,500*	2,695,000	53,367,000	.....	.....
Week ending Oct. 12	2,828,500 474,000*	.....	.....	.....	.....

Underlined figures indicate improvement in statistical position—decrease in production, runs to stills, gasoline stocks and imports.

* Estimated total production of the East Texas field, official and unreported.

** Import figures include all oil imported, for domestic use and in bond for re-export, it being impossible to make the separation in weekly statistics.

THE GENERAL situation in Texas continued very satisfactory with the Railroad Commission gradually tightening the reins of enforcement. Hot oil investigation by the investigating committee of the Texas House of Representatives, while, as expected, uncovering considerable irregularities in the enforcement of proration in the East Texas field, did not, in fact, find anything that was not known before. Captain E. N. Stanley succeeded Harry Miles as the Chief Proration Enforcement Officer in the East Texas field. The Texas Supreme Court is expected soon to hand down its decision for a rehearing of the Brown vs. Humble case. If the Court denies the plea for rehearing, the proponents of acreage inclusion as a proration factor in the East Texas field will again request permission to include acreage factor in determining allowables for various leases with the purpose of eliminating much entirely unnecessary drilling. Several other suits of secondary importance are pending at this time in Texas courts.

The situation in California continued very indefinite with local authorities claiming that the state's crude oil demand is around 600,000 bbl. per day for the last quarter of 1935, or some 100,000 bbl. per day in excess of the estimates of the United States Bureau of Mines. The Emergency Committee recommended lifting of all proration regulations from the following fields: Long Beach; Santa Fe Springs; Huntington Beach, Playa Del Rey; Alamitos Heights; and Mountain View. Apparently of major importance was the realization by the domestic oil industry of the fact that California oil fields were definitely over the peak of production and are now declining, and the thought that, if allowed to produce at the present rate, the natural decline will entirely eliminate California as a factor of overproduction and, as a matter of fact, it is generally believed that within two years California will experience a major shortage of crude oil production.

The Interstate Oil Compact Commission held its second meeting in Oklahoma City on October 11, at which meeting the Commission set up a fact finding agency to advise the industry as to the conditions throughout the country; decided to use the figures of the United States Bureau of Mines for the estimates of monthly market demand for petroleum and its products; decided to use the engineering staff of each state's regulatory bodies to make surveys of reserves, potential production and methods of production; decided to publish information between the compacting states and, similarly, to furnish this data to oil producing states not in the compact; and decided to fix the headquarters of the Commission at the residence of its chairman, at which place the Commission will meet quarterly, with the next session being in December. Governor E. W. Marland is the present chairman of the Commission and the next meeting will again be held in Oklahoma City. Four committees were appointed: on conservation, on coordination, on consumption and on imports and exports.

While it is not expected that the Interstate Compact will prove effective in actual enforcement, it will undoubtedly be of very considerable benefit in permitting close personal intercourse between various oil states, thus promoting good will.

Prices Sustained

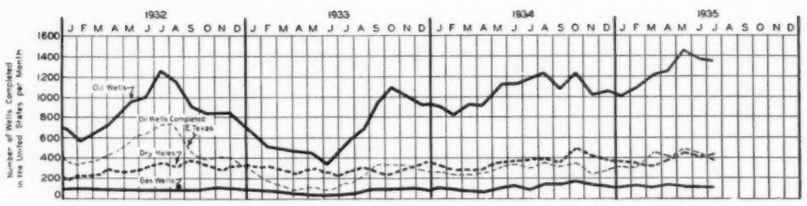
DURING the past month crude oil and gasoline prices remained virtually unchanged

and firm, even though prices in California continued weak and the situation in that state continued indefinite. Retail prices at service stations also remained firm due to very favorable weather conditions; and very few price wars were recorded east of the Rocky Mountains. The future trend is anticipated to be strong with continued strict production enforcement in the southwestern states, while the situation in California is not expected to affect central and eastern markets due, to some extent, to the unusually heavy European export demand caused by the Italo-Ethiopian conflict. The two recent threats to the market, Anahuac and Rodessa, have been definitely eliminated as large fields, with Rodessa field showing such rapid salt water encroachment that it may develop into a very secondary producing area. The situation in the East Texas field continued strong with the Texas Railroad Commission making very definite progress in curtailing hot oil production, which now does not exceed 30,000 bbl. per day, a volume absorbed locally and not affecting interstate markets.

During the past month refinery gasoline quotations remained unchanged for the fourth month in succession and in the middle of October very little gasoline was available outside of regular channels. Natural gasolines continued strong with the increasing fall demand.

Posted crude oil prices during October remained firm and unchanged at $1.00 per barrel for 36 gravity Mid-Continent crude and $1.00 flat per barrel for East Texas crude. There was less talk about further reductions in California crude oil prices and with production virtually unprorated, it is probable that present prices will continue until the potential production declines to within the market demand, which may take place early next spring.

Tank wagon/service station motor fuel prices per gallon, regular grade, including all taxes, in representative districts in the middle of October were: 15.05/19.3 cents in



U. S. drilling statistics: comparison of oil wells, gas wells and dry holes, with separation of oil wells in the East Texas field.

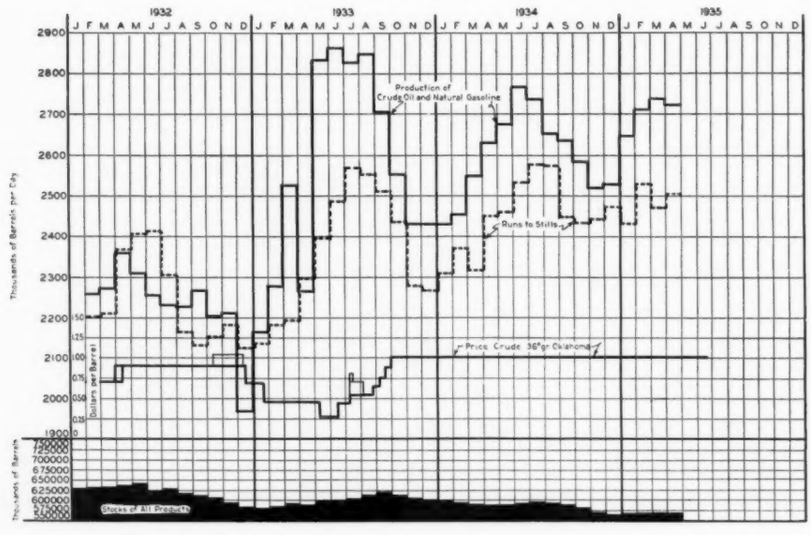
metropolitan New York (13.5/17.0 cents in Newark, N. J.); 13.0/16.5 cents in Boston, Mass., 12.0/13.5 cents in Providence, R. I., 15.5/16.0 cents in Chicago, 17.0/19.0 cents in Ohio, 14.0/16.0 and 10.5/12.5 (off 1.0) cents in San Francisco and Los Angeles respectively, with independents selling third grade motor fuel at service stations for 7.9 cents per gallon in Los Angeles, inclusive of all taxes; 16.0/18.0 cents in Oklahoma; 15.0/17.0 cents in Dallas and Fort Worth and 16.0/18.0 cents in Houston, Texas, with third grade gasoline in the East Texas area selling at from 9 to 10 cents per gallon at independent stations; 15.2/17.2 cents in St. Louis and East St. Louis; 20.5/23.0 cents in Montreal, Canada; all with a 2-cent differential for premium grade.

Refinery gasoline quotations in the Mid-Continent area remained firm and unchanged during the past month. Refinery gasoline was quoted on October 15 at 4¾–5 cents per gallon for 58–60 U.S.M. grade 62.9 and below octane rating in Group 3, Oklahoma market; 63.0–70.9 octane rating, U.S.M., regular grade, was quoted at 5⅝–5⅞ cents per gallon; and 71 and above octane rating, U.S.M., premium grade was quoted at 5¾–5⅞ cents per gallon. East Texas markets remained firm with prices on par or ⅛ of a cent per gallon under Group 3 quotations, Third grade motor fuel, restricted to interstate markets, was quoted at 3¼ cents per gallon. On the East Coast at Bayonne, U.S.M., grade 60.0–64.9 octane rating gasoline was quoted unchanged at 5¾ cents per gallon (3.39 cents gold*). Gulf Coast prices for export remained firm and on October 15 were quoted at 4½–4⅝ cents per gallon (2.70 cents gold*) for grade 58–60 U.S.M.

Natural gasolines remained unchanged during late September and early October and on October 15 grade 26–70 was quoted at 4⅛ cents per gallon (2.43 cents gold*) in Oklahoma; at 4 cents per gallon (2.36 cents gold*) in North Texas; and at 4⅜ cents (2.58 cents gold*) in North Louisiana.

Kerosene prices remained firm and unchanged during the last month. On October 15 grade 41–43 w.w. was quoted at 3¼–3½ cents per gallon in Group 3, Oklahoma market; and at 4⅝–4¾ cents per gallon (2.73 cents gold*) on the East Coast at Bayonne. Gulf Coast prices for export remained unchanged at 3⅞ cents per gallon (2.29 cents gold*) for 41–43 p.w. grade and at 3⅞–4 cents per gallon (2.36 cents gold*) for 41–43 w.w. grade.

U. S. production, runs to stills and price of crude oil in relation to stocks of all petroleum products.

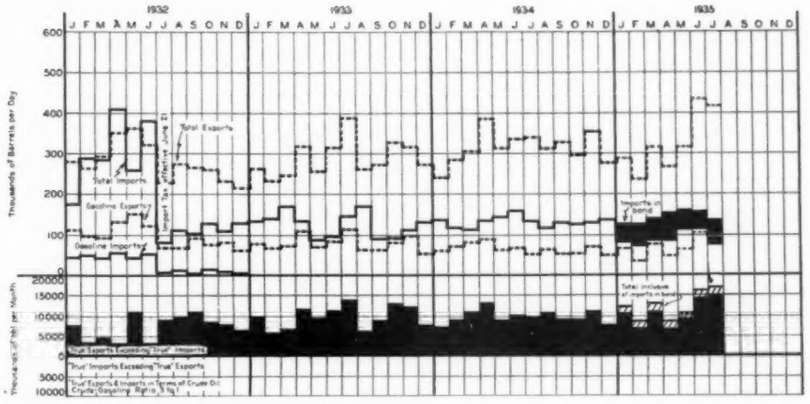


$114,740,190 Favorable Trade Balance

DURING August, 1935, total gross imports of all petroleum products into the United States amounted to 4,812,000 bbl., 151,500 bbl. per day, as compared with 4,224,000 bbl., 136,200 bbl. per day, imported during the preceding month; out of this total during August, 1935, 3,054,000 bbl., 98,400 bbl. per day, were imported for domestic use and 1,758,000 bbl., 56,600 bbl. per day, were imported in transit either for refining and re-export or for use in vessels in international trade. During the preceding month, July of 1935, 2,508,000 bbl., 81,000 bbl. per day, were imported for domestic use and 1,716,000 bbl., 55,300 bbl. per day, were imported in bond as indicated above. The crude oil imported for refining and re-export amounted in August, 1935, to 802,000 bbl. Therefore, during August the net imports of 98,400 bbl. per day for domestic use were within the former federal recommendation of 108,400 bbl. per day which was in force under N.R.A.

Exports of all petroleum products during August, 1935, decreased 10.54 percent below

* U. S. dollar at 41 percent discount.


1932
1933
1934
1935
J F M A M J J A S O N D
Thousands of Barrels per Day
Total Exports
Total Imports
Gasoline Exports
Gasoline Imports
Import Tax Effective June 21
Imports in bond
Total inclusive of imports in bond
Thousands of Bbl. per Month
True Exports Exceeding True Imports
True Imports Exceeding True Exports
True Exports & Imports in Terms of Crude Oil
Crude-Gasoline Ratio 3 to 1

Total U. S. imports and exports and gasoline exports, indicating imports in bond; and showing evaluation of true exports exceeding true imports.

the daily rate of the preceding month, reaching 11,577,000 bbl., 373,000 bbl. per day, as compared with 12,925,000 bbl., 417,000 bbl. per day, shipped during July, 1935. The August, 1935, total exports were 19.95 percent in excess of the shipments in August of 1934, when 9,643,000 bbl., 311,000 bbl. per day, were exported. Thus, the exports during June, July and August of the current year continued to be at the highest level since 1930, influenced by war demand in Europe and the Far East and by considerably increased automobile traffic in Europe. For the first eight months of 1935 the total exports of 80,539,000 bbl. exceeded by 6.15 percent the exports during the same period of 1934 when 75,875,000 bbl. were shipped. Exports of crude oil from the United States during August, 1935, continued in a large volume reaching 4,946,000 bbl., 159,500 bbl. per day, as compared with 5,832,000 bbl., 188,000 bbl. per day, shipped in the preceding month and as compared with 3,696,000 bbl., 119,000 bbl. per day, exported in August of 1934. Thus in August of 1935, crude oil exports constituted 42.7 percent of the total exports of all petroleum products. During the first eight months of 1935, crude oil exports reached 33,210,000 bbl., 136,800 bbl. per day, as compared with 26,665,000 bbl., 109,800 bbl. per day, shipped during the same period of 1934, an increase of 24.5 percent.

During the first seven months of 1935, the gross value of exports of all petroleum products reached the high figure of $135,884,876, as compared with the gross value of all petroleum imports of $21,144,686, therefore leaving an impressive favorable balance of $114,740,190; thus the value of imports of all petroleum products into the United States was but 15.57 percent of the value of exports of all petroleum products. The lubricating oils led in the value of exports in that period of time, being valued at $35,097,912; followed by crude oil valued at $34,354,658; by gasoline valued at $34,210,971; by fuel or bunker oil for vessels in international trade valued at $18,018,011; by kerosene valued at $9,050,578, by gas and fuel oil valued at $8,525,668; and by residual fuel oil valued at $4,950,076.

The above import figures, however, include imports in bond and if such imports, valued at $6,300,512, were excluded then the net favorable balance of United States is, in fact, $121,040,702; indicating that the actual imports amount to but 10.93 percent of the exports. The above figures illustrate in an excellent way the relative unimportance of imports into the United States as considered in the light of a very large volume of the export trade.

Record Crude Production

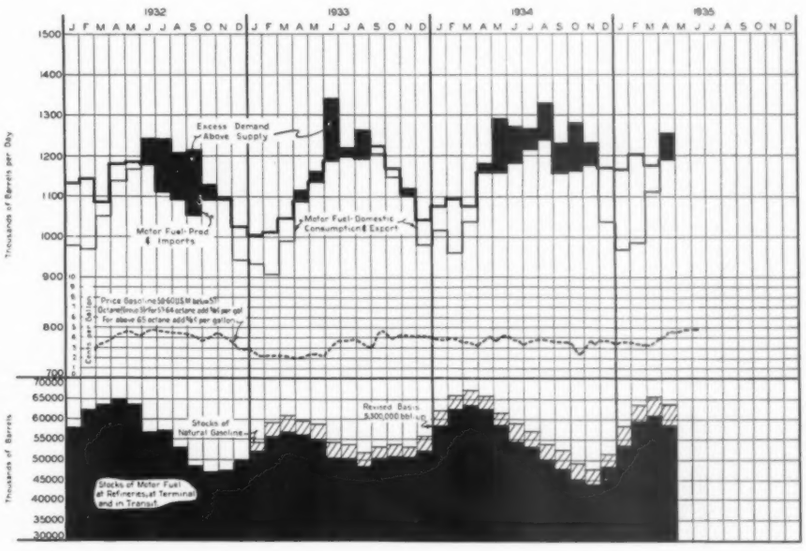
CRUDE oil and natural gasoline production during September of 1935, established an all-time record by reaching above 2,900,000 bbl. per day, about 60,000 bbl. per day above the crude oil and natural gasoline production during the preceding month when 2,840,000 bbl. were produced; this production being 268,000 bbl. per day above crude oil and natural gasoline production in September of 1934, an increase of 10.19 percent. The September, 1935, average daily crude oil production exceeded the recommendations of the United States Bureau of Mines by about 163,000 bbl. per day, by far the largest share of the overproduction again coming from California, which exceeded its quota by 3,965,000 bbl., while Texas overproduced but relatively an unimportant volume of 435,000 bbl. Oklahoma underproduced 710,000 bbl. and Kansas underproduced 237,000 bbl. during the same month. With the definite disappearance of Rodessa field from the horizon of threatening oil fields, the situation east of the Rocky Mountains appears very well under control and it is anticipated that crude oil prices will be fully maintained at the present levels throughout the winter. Crude oil overproduction in California, while appearing at this time as being in a critical state, may be, in fact, considered as the passing of the crisis, since all the flush oil fields of any importance are currently declining and in Kettleman Hills the reservoir pressure is noticeably dropping off in its heavily drilled area.

Crude oil runs to stills during September, 1935, averaged about 2,750,000 bbl. per day, or some 21,000 bbl. per day above the run to stills during the preceding month when 2,729,000 bbl. were refined. Total stocks of all petroleum products declined during August, 1935, by 7,959,000 bbl. to a total of 558,053,000 bbl., indicating very large daily gross withdrawals of 257,000 bbl.

Record Motor Fuel Demand

INDICATED domestic demand for motor fuel during August, 1935, averaged 1,384,000 bbl. per day, an increase of 4.15 percent above the daily average during July, 1935, when 1,329,000 bbl. were consumed per day; the domestic

U. S. production and imports, consumption and exports and price of motor fuel in relation to motor fuel stocks; showing excess daily demand over supply by black areas.


1932
1933
1934
1935
J F M A M J J A S O N D
Thousands of Barrels per Day
Excess Demand Above Supply
Motor Fuel Prod & Imports
Motor Fuel Domestic Consumption & Export
Price Gasoline 58 60 Oct. W. below
Octane Number Differential 64 octane add 1/4¢ per gal.
For above 65 octane add 1/2¢ per gallon
Cents per Gallon
Revised Basis 9,300,000 bbl. up
Stocks of Natural Gasoline
Stocks of Motor Fuel at Refineries, at Terminals and in Transit
Thousands of Barrels

demand during August, 1935, was 121,000 bbl. per day above the domestic motor fuel consumption in August of 1934, a very substantial and sustained increase of 9.57 percent; 167,000 bbl. per day above the domestic motor fuel consumption in August of 1933, an increase of 13.72 percent; and 38,000 bbl. per day above the domestic motor fuel consumption in August of 1931, the peak year before 1934, an increase of 2.82 percent. Thus, during August, 1935, the domestic motor fuel consumption established an all time record for monthly domestic demand and the sustained and tight markets for motor fuel during September and October suggest that the unusually heavy motor fuel demand will be carried into the above two months, favored by excellent weather conditions throughout the country.

The daily rate of exports of motor fuel decreased slightly to 91,000 bbl. per day in August, 1935, 6.19 percent below the preceding month; 30.0 percent above motor fuel exports in August of 1934; 44.0 percent above motor fuel exports in August of 1933; but 33.0 percent under the motor fuel exports in August of 1931.

On September 1, 1935, motor fuel stocks at refineries, plants, terminals and in transit, inclusive of natural gasoline, amounted to 51,510,000 bbl., a large decline of 4,778,000 bbl. as compared with stocks on hand on August 1, 1935, indicating that during August motor fuel demand exceeded supply by 154,000 bbl. per day. Motor fuel stocks, as of September 1, 1935, were 2,930,000 bbl. below the stocks on hand on September 1, 1934, when they totaled 54,440,000 bbl.

Effect of Federal Proration Recommendations in Principal Oil Producing States

	Sept. 1933 to Sept. 1935 Cumulative Overproduction		Sept. 1935 Over-production	October 1935 U. S. Bureau of Mines Recommended Quota	Daily Average Production for week ending	
	bbl.	% of total	bbl.	bbl.	Oct. 5 bbl.	Oct. 12 bbl.
Texas	39,770,000	49.2	435,000	1,025,5000***	1,069,000	1,070,000
Oklahoma	8,850,000	10.9	*	492,900	475,500	516,500
California	17,513,000	21.7	3,965,000	497,000****	623,000	643,000
Kansas	1,800,000	2.2	**	146,100	143,500	147,000
United States	80,742,000	100.0	4,890,000	2,544,200	2,760,500	2,828,500

* Oklahoma underproduced 710,000 bbl. in September.

** Kansas underproduced 237,000 bbl. in September.

*** Texas Railroad Commission reduced the State's allowable to 1,011,090 bbl. per day during October.

**** California field committees and the Umpire recommended that the State's production be reduced to 590,700 bbl. per day.

Business Conditions Improve

THE NEW YORK TIMES weekly combined business index remained virtually unchanged during the past month, standing at 88.4 in the week ending October 5, 1935, as compared with the September average of around 88.0. The NEW YORK TIMES index stood at 74.0 on October 1, 1934; at 78.0 on October 1, 1933; at 68.0 on October 1, 1932; and at 79.0 on October 1, 1931.

The business conditions throughout the country appeared to be taking a definite turn for the better as indicated by: The announcement of Secretary of Labor Perkins that in August factory employment was up 2.8 percent, while the payrolls were up 6.7 percent; the report of the Security and Exchange Commission that during August the volume of trading on all registered exchanges was 36 percent above July; the report of the Department of Agriculture that in August cash income of farmers was $549,000,000 as compared with $536,000,000 in August of 1934; the report of the New York retailers that sales were running as high as 25 percent above last year, this condition in general prevailing in other large cities; the prediction of Roger Babson, the noted statistician, that the country will be out of the depression within six months; and the settlement of the shortest strike in the history of the bituminous coal industry, lasting but six days and settled by compromise between labor unions and operators. All these factors will undoubtedly favorably affect the fall and winter demand for motor fuel and if the weather is not too unfavorable, an unusually large increase in consumption may be anticipated.

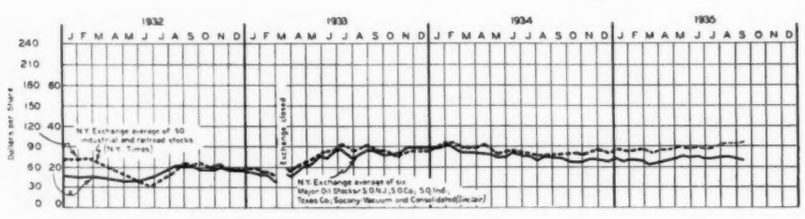
The improved business conditions were reflected in a very appreciable rise of securities on the New York Stock and Curb Exchanges, which advanced to such an extent that they brought the warning from Charles R. Gay, President of the New York Stock Exchange, that there was a danger of a "runaway stock market inflation" which may easily lead to "a crash as violent and dangerous as that of 1929".

The most interesting feature of the advance was that the prices of the oil securities lagged behind the general advance, as indicated on the accompanying graph, and as was the case in the 1929 bull market.

Oil Field Developments

DURING the past month no new discoveries of any consequence were made in the United States. In the Rodessa field new completions brought the total number of producers to ten, most of which are showing salt water encroachment, and it can be presumed at this time that the field will be of very secondary importance and short-lived. In New Mexico additional wells were completed in the Monument field, further emphasizing its importance and large areal extent; across the border in Texas, in Yokum County, a wild-cat well showed some oil at around 5,100 ft. and it is given a fair chance to become a producer, in which case the limestone producing area of eastern New Mexico and West Texas will be extended some 30 miles to the north. The Anahuac field in Chambers County, Texas has been more definitely defined to a relatively small area of around 4,000 acres. In Oklahoma, the Fitts pool, with some 190 producers and a potential of about 560,000 bbl., became the largest field in Oklahoma; followed by Edmond field, with a potential of 265,000 bbl. and some 28 wells; while Oklahoma City dropped into the third place with a potential of around 200,000 bbl. Additional completions in Michigan brought the daily production to a record figure of 52,500 bbl., due to large completions in the Crystal Township field.

Six major oil stocks in relation to 50 industrial stocks on the New York Stock Exchange.


1932
1933
1934
1935
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
240
210
180
150
120
90
60
30
0
60
40
20
0
Dollars per Share
N.Y. Exchange average of 50 industrial and railroad stocks (N.Y. Times)
Exchange closed
N.Y. Exchange average of six Major Oil Stocks (S.O.N.J., S.O.Ca., S.O.Ind., Texas Co., Socony-Vacuum and Consolidated (Sinclair)

Rodessa — Louisiana

ADDITIONAL completions during the past month brought the total number of the oil wells in this new field to ten, with some 15 wells drilling at this time. The salt water encroachment assumed dangerous proportions while wells were producing 1,750 bbl. per day but much of the water was temporarily eliminated with the reduction in the per well allowable to 1,000 bbl. per day; it is quite apparent that if the well allowable is reduced, as it should be, to 150 to 200 bbl. per day, the salt water will be entirely under control. The water encroachment appears dangerous not only because of the actual production of salt water, in some wells ranging up to 50 percent, but also because even in the wells not producing any salt water the bottom hole and flowing temperatures are excessively high. The bottom hole temperatures in Rodessa field are around 190 degrees, requiring usage of ice in cementing, while flow temperatures are in excess of 100 degrees.

The Louisiana Conservation Commission indicated that it will strictly enforce the curtailment and the gas waste in the field and, in fact, as has already been indicated, reduce the well allowable to 1,000 bbl. per day on October 2, and has subsequently shut down entirely a producer in which the gas/oil ratio was excessive. In the case Rodessa field extends into Texas, cooperative effort by Texas and Louisiana's Conservation bodies will be made, as has been tentatively agreed.

BASIL B. ZAVOICO

World Petroleum Abstracts

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Industry.

Dr. O. W. Wilcox

Petroleum Geology

Late Paleozoic Crustal Movements in Europe and North America.—Raymond C. Moore, in BULL. AM. ASSOC. PETROLEUM GEOLOGISTS, vol. 19 (1935), No. 9, pp. 1253–1307.

The present paper reviews evidences primarily from North American areas bearing on the age of Late Paleozoic crustal movements and compares this record with that of Europe. At least nine series that are separable on the basis of structural and paleontologic criteria appear to be recognizable in the post-Devonian section of North America. The breaks between these stratigraphic series or "blocks" represent orogenic or epirogenic movements. In general, it appears that times of orogenic movement in Europe are matched by epirogenic movements in North America and conversely that orogeny in America may be represented by epirogeny in Europe.

Responsibility of Geologist in Sale of Oil and Gas Securities under the Securities Act.—Irving Perrine, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 7, pp. 1038–1042.

This paper presents a brief summary of the Securities Act, setting out its provisions relative to the sale of oil and gas interests, its exemptions, requirements for registration, forms to be used in registering royalties, working interests, *et cetera*. No sales to the public are exempt from registration unless certain conditions are fulfilled. The work of the geologist through appraisals, geologic reports, estimates of ultimate production, and published reports of all oil and gas fields, more especially the new fields, and his new responsibility to the public are discussed.

Two Methods for Estimating the Porosity of Limestone.—W. H. Thomas, R.A.E. Chisholm and A. B. Cameron, in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 21 (1935), No. 142, pp. 725–733.

The property of porosity of rocks is of paramount importance when it is desired to know under what conditions the oil is held below ground and what are the physical properties that control the flow of oil to the bottom of the well. Much attention has been given to the porosity of sands, but little attention has been bestowed on the porosity of oil-producing limestones. For facilitating such studies the authors have developed two methods, one being a "pyknometer method" in which is determined the volume of liquid that is capable of being absorbed by a known volume of the limestone core. The other, or "core method," measures the porosity by observing the reduction of pressure consequent on releasing a known quantity of compressed air into the core, the volume of which is known. Pore size is of equal importance with porosity and is measured as follows: A prepared surface of the limestone is impregnated with Bakelite that has been colored by means of an intense dye, such as methyl violet. The excess of Bakelite is ground off; the pores are then seen as highly colored threads and spaces which may be measured by means of a microscope fitted with an eye piece micrometer. For this examination of pore space it is necessary to cut at least two specimens each at right angles to one another.

Geology of Texas Panhandle Oil and Gas Field.—Henry Rogatz, in BULL. AM. ASSOC. PETROL. GEOLOGISTS, vol. 19 (1935), No. 8, pp. 1089–1109.

The Texas Panhandle oil and gas field is probably the most extensive field in the world, having an area of more than 1,800 square miles and a length of about 120 miles. When the territory is completely developed it is probable that there will have been outlined one continuous oil and gas field, and all of the pools, now seemingly separate, will have been found to be connected.

There have already been extracted from this field almost 250,000,000 bbl. of oil from about 3,250 wells. It is probable that at least 500,000,000 bbl. are still recoverable by present methods from the shallow producing formations in proven and potential areas. Artificial flooding and other methods of secondary recovery may increase the ultimate yield enormously. At present, the average daily production of the field is approximately 60,000 bbl. Almost 200 wells are now drilling.

This field is undoubtedly the largest continuous gas-producing area known.

As explained by the author, oil is found in formations along the flanks of an old buried granite ridge trending northwest and southeast. Gas is found in formations along and on the crest of this ridge. The beds are arched over the ridge as a result of compaction of sediments or diastrophic movements, or both. The shallow Permo-Pennsylvanian non-red beds are divided into five zones from bottom up: "granite wash," dolomitic arkose, coarse white dolomite, fine brown dolomite, and anhydrite. The first four are oil and gas reservoirs. Oil usually accumulates where the porous portions of these four zones intersect a plane slightly above sea-level. There is definite demarcation between the sweet and sour gas. This results from the gravitational separation of the heavy hydrogen sulphide into that portion of the gas situated low on the ridge. At the time of accumulation of oil and gas, the eastern end of the ridge was higher, generally, than the western, resulting in the greatest accumulation of sour gas in the northwest, while only sweet gas accumulated in the southeast. This condition also accounts for the heaviest oil being on the northwest. Subsequent tilting now gives the axis of the ridge a southeast plunge.

New Experience on the Accuracy of Gravimetric and Pendulum Measurements.—A. Schleusener, in OEL UND KOHLE, vol. 11 (1935), No. 36, pp. 635–640.

Careful checking of a large number of gravimetric measurements in different districts showed that the average error for all observations was +0.4 milligal. The average error of the pendulum method was +2.0 milligal. This difference in accuracy, together with cost considerations, indicates that the pendulum method is not economical for practical geophysics. The gravimetric method therefore should be used for regional surveys, with the pendulum method restricted to general checking.

Thermometry as a Method of Geophysical Exploration.—M. Paul, in OEL UND KOHLE, vol. 11 (1935), No. 36, pp. 641–643.

If it is true, as is generally assumed, that the internal heat of the earth is gradually passing outward through the earth's crust, then the rate of this escape of heat should vary from place to place according to the presence of geological formations that differ in heat conductivity.

To test this possibility a large series of holes two meters deep (so as to reach beyond the zone of seasonal temperature changes) was sunk in the earth above and beyond the edges of a salt dome in Hannover and temperature movements in these holes were measured. These temperature movements were more pronounced above the salt dome than beyond its edges as defined by a gravimetric survey. In other words, from the geophysical standpoint the temperature method agreed fairly well with the gravimetric method, thus indicating the practicability of thermometry as an additional method of geophysical exploration.

Combustible Gases in the Ground Air of Formations Overlying Oil Deposits.—A. Graf in OEL UND KOHLE, vol. 11 (1935), No. 36, pp. 644–648.

This paper deals with a possible new method of geophysical exploration for oil. The basic assumption is that gaseous hydrocarbons under heavy formation pressure will tend to pass outward to the surface through the overlying rocks, either by diffusion or by cracks or fissures. In that case the air in the rocks and earth over oil deposits should be richer in combustible gas than in those parts of the

earth's crust remote from oil deposits. By making use of an apparatus devised by H. Laubmeyer, by which the presence of small amounts of combustible gases in air can be detected, it has been in fact shown that there is a measurable accumulation of hydrocarbon gases in the air of rocks and soil above oil deposits.

The possibility of making use of this fact is discussed. There are more than 100 salt domes in Germany, of which it is not known whether they carry oil or not. It is suggested that by examination of the ground air above these domes it may be possible to decide which are most likely to be productive.

Natural Gas

High Pressure Fractionating Plant.—J. Albright, in REFINER, vol. 14 (1935), No. 9, pp. 421–423.

A plant for the "superfractionation" of natural gas has been built and is in successful operation at Lucinda, Pa. This plant fractionates and separates ethane, propane, butane and heavier hydrocarbons, in such a manner that commercially pure ethane may be cut as an overhead product, while propane and other hydrocarbons are removed as a base cut. The gas has to be drawn from the wells by a vacuum as low as 28 inches. After compression and cooling at five lbs. pressure, all gasoline is removed and the residual gases are fractionated and placed in storage according to demand. The success of the plant has been such that it is being enlarged to handle 2,000,000 cu. ft. of gas per day.

History, Use and Manufacture of Carbon Black.—R. G. Allen, H. W. Price and E. B. Reinbold, in REFINER, vol. 14 (1935), No. 8, pp. 384–388.

The authors of this paper give an interesting and very readable article on the manufacture and handling of carbon black, which finds its major use in the rubber industry, mostly in the manufacture of automobile tires.

Gum Deposits in Gas Distributing Systems.—C. W. Jordan, A. L. Ward and W. H. Fulweiler, in IND. ENG. CHEM., vol. 27 (1935), No. 10, pp. 1180–1190.

It has now been established that nitric oxide is the cause of the formation of vapor-phase gum in gas lines. This report deals with the merits and demerits of methods for getting rid of it. The authors, working in the laboratories of the U. G. I., have devised an inexpensive continuous process that will reduce the nitric oxide content down to a concentration of the order of 0.0000005 percent by volume. The process involves contacting the gas with iron sulphide under carefully prescribed conditions.

A Gas Mixing Station.—J. C. Albrigth, in OIL WEEKLY, vol. 78, (1935), No. 8, pp. 30–37.

In the Kettleman Hills field gas is produced from a "white sand" horizon and a "black sand" horizon. These gases go mostly to natural gasoline plants through a gas main, and under varying field conditions some of these plants have been receiving more of the one kind of gas than of the other. The wet gas is thus of variable composition, putting the plants under the necessity of continually rearranging the operating procedure in order to produce the desired quantity and quality of gasoline.

To solve this problem the Kettleman Hills North Dome Association installed a central mixing header which assures that each plant will receive its proper proportion of both types of gas. The design and construction of this mixing arrangement presented a number of engineering problems, the solution of which is described in detail in the paper.

Isopentane.—I. N. Beall, in REFINER, vol. 14 (1935), No. 9, pp. 437–439.

Isopentane and pentane are predominant constituents of natural gas. Isopentane is of particular interest because its boiling point, 82.3° F., lies between that of normal butane and normal pentane. It is therefore a highly valuable constituent of motor fuel, its properties being such as to give ease of starting without much loss by vaporization. This is an important point for those engaged in the manufacture of aviation gasoline from natural gas, as a sharp cut between butane and isopentane would give a stable gasoline of high volatility. Isopentane has the same molecular weight and formula as normal pentane; the two isomers can be separated by fractional distillation, and it is advisable to do this if the products are to be used in the manufacture of amyl alcohol.

The author here presents an extended table for this hydrocarbon which will replace most of the tedious approximation methods now used for calculating volumes, pressures, densities, heat content and entropy of this compound.

Drilling

Direct-Reversing Diesel Engine Operating a Rotary Drill.—W. A. Sawdon, in PETR. ENG., vol. 6 (1935), No. 13, pp. 29–32.

A Cooper-Bessemer Diesel engine serving as a prime mover direct connected to the draw works is being used in drilling a deep well with rotary equipment by the Associated Oil Co. in California. This innovation has so far given excellent results and is considered to be quite as flexible in operation as a steam engine.

Behavior of Cement Grouts Under Oil Well Conditions.—S. L. Meyers, in PETR. ENG., vol. 6 (1935), No. 12, pp. 54–56.

For mixing cements for oil wells it is recommended that only water fit to drink be used; it may be doubtful if well water ever contains sufficient detrimental material to be the sole cause of cement failure, but as a precaution it is advisable to avoid water having a large amount of salt. In order to aid in bonding between well wall and cement, and casing and cement, it is desirable that a hardening grout should expand to some extent; rate of expansion is a property that, along with strength and permeability, is affected by the use of low percentages of mixing water.

In most cases contamination of the cement with mud in the well does little harm, but if the circulating mud has been too thick, or where the casing is not concentric with hole, chanelling of cement up through the mud may leave places through which water can enter.

It is important to note that if the hydrostatic head on the fluid cement column is not so great as the gas or well fluid pressure behind or below the earth wall, the outside pressure will be released through the cement column, and in so doing will agitate the cement and keep it from setting, resulting in a bulky, colloidal mass which does not develop strength. It appears that this condition is a major cause of cement failures. (The obvious inference is that control of the hydrostatic pressure is of importance.)

Yield-Point and Viscosity of Drilling Fluid.—W. C. Woolgar, in OIL AND GAS JOUR., vol. 34 (1935), No. 10, pp. 40–41.

The author advocates the use of the Stormer viscosimeter for obtaining a true knowledge of the viscous state of a drilling mud. Existing objections to the use of this instrument are shown to be not so serious as has been supposed; with suitable calibration the Stormer viscosimeter may be able to give more useful information than before to the drilling engineer.

Bibliography on Oil-Well Cement.—A. Reid in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 21 (1935), No. 142, pp. 737–740.

Articles on oil-well cementing practice are numerous and authoritative; articles on oil-well cement are scarcer and less satisfying. But it is no less important to know the nature of the cement that is being used than to know how to handle it. Anyone wishing to make contact with the research that has been bestowed on this subject should find this bibliography of use. It includes 83 titles.

Extending the Life of Drilling Bits.—C. P. Bowie, in OIL & GAS JOUR., vol. 34 (1935), No. 15, pp. 36–40.

This article summarizes information collected by the Bureau of Mines on the repairing of drilling bits, by which is chiefly meant the reshaping and hardening of worn bits.

The material used for this purpose is tungsten carbide, which appears on the market under numerous aliases, as borite, carboloy, diamondite, hastellite, sulamite, triamant, and others. It is a material that has enormous tensile and compression strengths; its hardness is somewhat less than that of the diamond, but it will scratch quartz. It is nearly infusible, so it cannot be attached to a steel surface by ordinary welding; the usual method is a sort of "inlaying" process.

The procedure of one of the large oil companies in hard surfacing a fishtail bit is as follows: When the bit is brought into the shop from the field the hard-surfacing material left on it from the previous facing is swept off with an oxy-acetylene torch. This process is facilitated by scraping the metal, as it is heated, with the edge of a piece of strap iron three-quarters

inch by 1½ by 18 inches bent at one end in much the same way as a fire poker. The metal comes off in chips and crumbs which are collected, melted and molded into rods about one-quarter inch by 10 inches for use in subsequent refacing jobs. When all the hard-surfacing material has been removed the bit is heated in a forge, dressed, and ground to the desired subgauge. It is then normalized. Half-round "shapes" of tungsten carbide about one-quarter inch in diameter by three-quarters inch in length are placed along the cutting edge of the bit. These "shapes" slope upward (when the bit is in a vertical position) at an angle of about 60 degrees to the edge of the bit and are spaced at intervals of about 1 inch. The entire surface of the bit for about 2½ inches back from the cutting area is then covered with a layer of hard-surfacing metal. This ranges in thickness from a film at the greatest distance from the edge of the bit to about five-eighths inch along the cutting edge and covers entirely the tungsten carbide "shapes." As a rule, the company does not permit excessive wear on a bit before it is returned to the shop for resurfacing.

The average cost of hard-surfacing a bit with various brands of materials ranges from about $1.50 per inch of blade for large to $1.75 for small bits, but these costs are small in proportion to the benefits obtained. According to information collected by the Bureau of Mines the rate of drilling is accelerated 2 to 10 times, the footage drilled per bit being often more than quadrupled. The closing sentence of the paper is worth quoting: "Today no operator who considers efficiency and economy will permit wells to be drilled without using hard surfaced metals, especially where deep holes are required."

Oil Well Operation

COMPLETING WELLS WITH OIL.—B. Mills, in OIL WEEKLY, vol. 79 (1935), No. 3, p. 43.

An oil company in East Texas has found the use of oil for drilling-in low pressure wells profitable. After running in and cementing the casing the mud in the hole is replaced with East Texas crude oil as the circulating medium and drilling into the producing formation is resumed and the well continued to the desired depth. This use of oil has justified itself by the increased initial production from wells in this area.

A SIMPLIFIED WELL DYNAMOMETER.—J. C. Slonneger, in PETR. ENG., vol. 6 (1935), No. 12, pp. 51–52.

Heretofore the need of a well designed "well weighing" instrument for everyday use has not been sufficiently recognized. By "well weighing" is meant estimation of the rod line pull of oil well equipment. In the absence of such an instrument the weighing of the well could be done only by a trained technical man, and the actual operator of the well was left without means of ascertaining the condition of the sub-surface equipment other than the feel of the polished rod. It is true that many operators have developed a feel that is almost uncanny, but still there remained need for some instrument that would register the variations in the polished-rod or rod-line load that could be quickly applied by non-technical men. Much, no doubt, has been lost for want of such an instrument.

The author describes a simplified dynamometer, known as the Falk Wellometer, by which it is aimed to meet these everyday requirements. The principle on which it has been designed is that of a telemeter; a measured portion of the rod upon which the load is to be determined is gripped by clamps and the change in length of that measured portion as the load varies is magnified and indicated on a dial instrument; the pull is thus directly stated in pounds. The information thus gained may be used for bringing the central power in good balance; the conditions of distant wells will be indicated in the dial reading, even though each well about the central power has its own peculiar pumping cycle. The instrument can be attached or removed in not more than three minutes.

GAS-OIL SEPARATORS.—J. W. Hardy, in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 21 (1935), No. 142, pp. 741–752.

Recent developments in production methods have created a demand for a gas-oil separator whose most important function is reliable complete separation of the gas from the oil so that small changes in gas-oil ratios may be immediately observed and recorded. Separation with the object of providing field gas supply, though still important, has become a secondary consideration compared to the importance of being able to measure the gas produced from the well. The first essential, therefore, in a separator is a reliable liquid seal over the oil outlet. This is obtained by some form of float control valve, which although simple in theory offers various difficulties in working practice.

Oil engineers interested in this matter should find this discussion and the accompanying drawings of interest.

DEVELOPMENT OF WIRE ROPE PUMPING IN ROUMANIA.—Percy R. Clark and Lutz F. W. Schropp, in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 21 (1935), No. 142, pp. 691–700.

Some of the undoubted advantages and particulars of wire rope pumping are listed in this paper. One is the greater speed of lowering and extracting the plunger, there being no couplings to unscrew. This ease of extraction is of especial importance with paraffinous oils, where frequent cleaning of the pumps is necessary. Another is that cheaper pumps can be used with wire rope than with rod pumping. A third is the ease with which connection can be made between plunger and rope.

The disadvantages of a rope, as compared with a sucker rod, are its flexibility and stretch, or tendency to elongate, and in some respects its elasticity. When using wire rope in this work an effort must be made to modify its inherent qualities in the above named particulars. This may be accomplished by weighting the rope with sinker bars when the rope is first put in operation, and by regular inspections to take up any permanent elongation that may occur. It is of particular importance to make regular inspections at the two extremities, as these are the points where breakages usually occur. Tendency to kink may be suppressed by establishing proper weight ratios, and twist may be counteracted by use of a specially constructed rope socket. Other difficulties may be minimized by special packing of the stuffing box, accurate centering of the rope, and proper construction of the rope clamps, which are best made of hardened rubber or very soft bronze. The use of suitable guides to prevent cutting into the tubing, especially in the case of crooked wells, is also necessary.

Elongation of the rope is considered the most difficult problem, but this has been considerably reduced by the introduction of new types of rope, in which there is a minimum of vegetable fiber.

In wells that have a tendency to become sanded up, rods are easier to manipulate than a wire rope, but there are, nevertheless, ways of minimizing this trouble.

NACODOCHES OIL MINES.—B. Mills in OIL WEEKLY, vol. 79 (1935), No. 1, pp. 27–30.

In the Nacodoches oil field the oil formations are shallow; the oil contains little kerosene, but yields a high grade lubricating oil. At present, attempts are being made to recover the oil by regular mining methods. Shafts will be sunk to the producing zones and galleries run out from the feet of the shafts to drain the oil within reach of the pumps.

The experiment is considered of interest because, if successful, the same method may be applied to other shallow fields that cannot well be exploited by the ordinary methods.

Pipe Lines

"NON-STOP" SCRAPER GUN.—Elton Sterrett in OIL WEEKLY, vol. 79 (1935), No. 1, p. 37.

In an East Texas pipeline, accumulations of paraffin made frequent resort to scrapers necessary to keep the line clear. Such scraping operations necessitated shutting down and draining the line. To obviate this inconvenience a section at the end of the line was converted into a chamber in which a scraper was kept ready for action. By a simple by-pass arrangement it is easy to deflect the main flow of the line behind the scraper and send it ahead whenever mounting pressure indicates excessive clogging.

"HALF SOLING" A PIPE LINE.—Elton Sterrett in PETR. ENG., vol. 6 (1935), No. 13, pp. 42–44.

A unique repair job was carried out on a section of eight-inch pipeline passing through a marsh. This section was found to be badly corroded on the bottom, but relatively uninjured on the top. The line was being operated to capacity, and to shut it down while cutting out and replacing the damaged section would have been inconvenient and costly. To avoid this, the following plan was executed: the bottom of the line was exposed and cleaned, and all corrosion pits filled by spot welding. Then

sections of 9⅝-inch casing were split longitudinally with an oxy-acetylene torch, the halves thus obtained were fitted under the pipeline, clamped tightly in place and arc-welded to the sides of the line. It is considered that the repairs thus made will last during the effective life of the line as a whole.

VOLTMETER TO DETERMINE POLARITY OF PIPE.—Dave Harrell, in OIL AND GAS JOUR., vol. 34 (1935), No. 10, p. 39.

In studying corrosion of pipe lines and its accompanying manifestations of galvanic currents one of the big problems has been to determine the polarity of the pipe to the soil in which it lies. After much experimentation the author has succeeded in constructing a rugged portable high resistance voltmeter reading to 0.01 volt either side of the neutral position and making a record of 1 milliampere of plate current per volt of impressed grid potential. With this instrument a high degree of correlation between corroded pipe and electro-positive areas has been obtained.

Asphalt and Tar

ROADS OF OIL MAT TYPE SURFACE.—Anon. OIL AND GAS JOUR., vol. 34 (1935), No. 10, p. 41.

A new and relatively inexpensive farm-to-market road is constructed by scarifying the earth to a depth of 4 or 5 inches, piling the loose earth into the center of the roadway, where it is picked up by an automatic mixer and thoroughly mixed with an asphaltic oil, spread, and rolled in one operation. The surface does not bleed nor become sloppy and can be opened to traffic almost immediately.

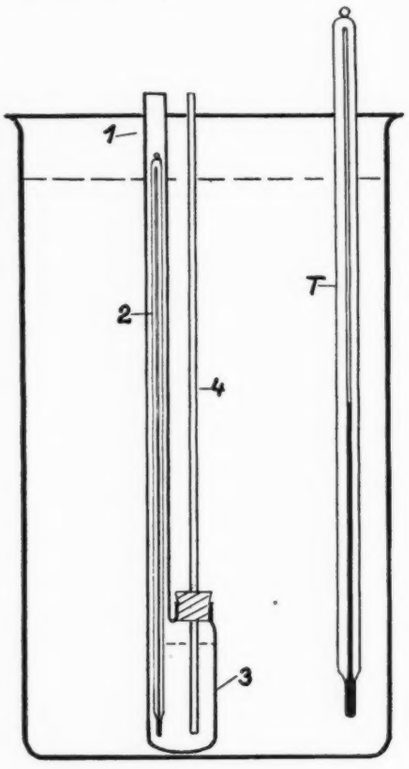
This method is recommended for two reasons: it provides an inexpensive system of good farm-to-market roads at a very low cost (less than $1,000 a mile) and an ideal and almost unlimited project for work relief.

CHARACTERIZATION OF TARS AND BITUMENS BY THEIR TEMPERATURE-VISCOSITY RELATIONS. — L. Ubbelohde, Ch. Ullrich and C. Walther, in OEL UND KOHLE, vol. 11 (1935), No. 36, pp. 684–690.

It has been shown by Ubbelohde (see his recent book: ZUR VISCOSIMETRIE) that the viscosity of a mineral oil is a function of the temperature in such a way that when viscosity in centistokes is plotted against temperature there is produced a straight line, the slope of which is characteristic of the oil, and that this relation affords a new way of classifying lubricating oils.

Since tars, bitumens and asphalts are composed of hydrocarbons it may be predicted that their temperature-viscosity relations will conform to the same mathematical law as the more fluid hydrocarbons. This has now been proved to be the case.

For determining the viscosity of a tar the authors used the apparatus shown in the accompanying drawing. The bottle (*3*) has a long tube (*1*), in which is placed a thermometer (*2*). There is also a capillary tube (*4*) (about four millimeters in diameter) which is the actual viscosimeter. The bottle (*3*) is supplied with a definite volume of the tar or bitumen and is put under the constant pressure of a column of water of a definite height (the arrangement for applying this constant pressure, corresponding to a water column of about 600 millimeters, is not shown in the diagram). The bottle is submerged in a bath maintained at the desired temperature, which is read by the thermometer (*T*).



In making the determination the bottle and contents are brought to the desired temperature; pressure is applied and the time required for the tar to rise a measured distance in the capillary (*4*) is noted.

Two viscosity measurements are sufficient for drawing the entire curve, which, as before stated, is a straight line. The results are plotted on a diagram previously made up by use of the Walther formula:

$$W = W_1 + m(\log T_1 - T_2$$

wherein $W = \log \log (V+0.8)$, V the kinematic viscosity in centistokes, and m is a constant expressing the temperature viscosity relation. (See Ubbelohde's book.) The viscosimeter is to be previously calibrated by means of a liquid oil of known kinematic viscosity.

The practical use of such measurements on tars, bitumens and the like is that they allow calculation of the temperature to which the material must be warmed in order to be poured on the job, and also to calculate whether the material is likely to become too soft in summer or too brittle in winter.

Acceptable values for viscosity can also be obtained with the usual tar consistometer if the measurements are made at about 15° C. above the drop point by the Ubbelohde method.

CORRECT CHOICE OF ROAD BUILDING MATERIAL.—D. M. Wilson, in PETROLEUM, vol. 31 (1935), No. 20, pp. 1–2.

One of the newer methods for testing the suitability of bitumens and asphalts for road-making purposes is outlined. This consists of a comparison of colors in a dilute solution (0.25 gram of bitumen in 100 cc.) of tetrachlor ethylene (CCl_2:CCl_2). The accompanying table shows the range of color values:

	Penetration at 25° C.	Color Value: Neutral	Orange	Yellow
Asphalts				
St. Jean	79	1.4	6.3	32.3
Sizilien	76	2.4	7.1	40.5
Travers	73	2.0	8.5	49.5
Trinidad Bitumen and Mixtures				
Trinidad Epuré	11	2.1	6.9	41.0
75% Trinidad Epuré, 25% Texaco Flux	71	1.1	6.1	35.8
50% Trinidad Epuré, 50% Venezuela 45	36	4.5	11.0	44.5
50% Trinidad Epuré, 50% Panuco 45	36	2.6	9.7	47.7
Asphalt from				
Panuco crude	45	3.3	11.0	45.7
Mexiko crude	40	7.2	12.8	49.0
Venezuela crude	42	7.1	12.9	40.0

The harder the bitumen the darker, in general, will be the color. The author considers that this color test, taken in conjunction with the results of other physical methods of testing, will give valuable indications.

PROPANE PROCESSES FOR REFINING OF LUBRICATING OILS. I. DEASPHALTING.—Ulric B. Bray and W. H. Bahlke, before Petrol. Div., Am. Chem. Soc., San Francisco, 1935.

The properties of liquid propane have been found to be such that it is advantageous in separating asphalt, resins, wax, and non-paraffinic constituents from the paraffinic constituents of a reduced crude to produce high quality lubricating oils. The desirable paraffinic constituents are quite soluble in propane from below the normal boiling point to a temperature near the critical. For each of the undesirable constituents there exists a certain temperature range where their solubility is so low in comparison with the desirable paraffinics that effective separation can be made through the use of propane. The solubility of these compounds has been made the subject of a physico-chemical investigation and the action of propane in deasphalting and deresining is explained with the aid of phase diagrams.

Petroleum Refining

USE OF AMMONIA IN CORROSION PREVENTION.—J. W. Smith, in REFINER, vol. 14 (1935), No. 8, pp. 393.

This short but interesting paper describes the practical use of ammonia for combating corrosion in a refinery where the vapor lines had to be rebuilt about once every three months. After considerable experimenting, an arrangement of equipment was perfected

for admitting gaseous ammonia under strictly uniform pressure into the bubble tower above the flash point. Equipment loss was immediately reduced to a satisfactory point, provided that the water stream coming over with the overhead cut is maintained at a pH of 7.0–7.2. For controlling the pH within these limits a daily sample of this water is taken; the most satisfactory method of effecting this control is by a Hellige tester, using bromthymol blue color plate and indicator.

If the pH of the overhead water is less than 7.0 it may lead to corrosion, as shown by the ferrocyanide test; if the pH is above 7.2 there will be corrosion of brass and admiralty condenser tubes, and moreover there will be an excessive consumption of ammonia.

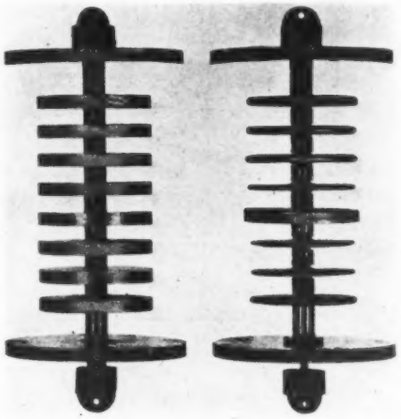
SELECTIVE DISTILLATE REFINING.—Sumner E. Campbell, in REFINER, vol. 14 (1935), No. 8, pp. 381–383.

The author describes a patented process for refining light distillates, with subsidiary processes for recovering by-products, particularly as applied to straight run California distillates. The apparatus used consists of a battery of eight washing towers connected in series. The first six of these towers are filled to near the top with a packing material, preferably No. 16 silica. The first two towers contain a small quantity of a 15 percent sodium carbonate solution. The crude distillate passing upward through the soda solution is deprived of certain impurities, chiefly organic acids. The next two towers contain a 10 to 20 percent solution of caustic soda which removes the phenols and naphthenic acids that were insoluble in the sodium carbonate solution. The distillate, now freed from naphthenic acids and phenols, is washed in towers Nos. 5 and 6 with a 50 percent solution of sulphuric acid to trap basic nitrogen compounds and certain impurities that may have an unstable color. The distillate next traverses the last two towers, which are filled with a suitable decolorizing clay, where final color stability is conferred on the gasoline. The outfit is provided with equipment for withdrawing the spent solutions and replacing them with fresh.

The spent sodium carbonate solution is worked up for the organic soaps it contains; phenols are recovered from the spent caustic solution, and the sulphuric acid solution is treated to recover the free nitrogenous bases; these bases can be used in the compounding of agricultural disinfectants.

CORROSION TESTS IN VARIOUS REFINERY SERVICES.—J. E. Pollock, E. Camp, and W. R. Hicks, in METALS TECHNOLOGY, August, 1935, T. P. 639.

In the oil-refining industry, steel comprises by far the greatest proportion of the materials used in construction work, but with an enormous number of alloy steels and nonferrous alloys available and a greater knowledge of their properties and corrosion resistance, a substitution first in the "hot spots" and then in locations of moderately severe corrosive conditions will be made as the greater expense can be justified. In new construction work, advantage is taken of the experience already gained and appropriate materials used, whether for high temperatures and pressures demanding additional strength or for corrosive conditions. The locations, however, where equipment in operation constantly requires replacement will soon become evident, as will the necessity for replacement in more resistant materials, if considerable down-time is to be avoided.



In what direction and how far to go in the matter of alloys then becomes a question of the highest importance. Obviously, any replacement with more costly material must be justified economically by the promise of longer life, thereby saving both material and installation costs besides the reduction of loss of production. Where the equipment is overcapacity and a regular schedule of cleaning periods is in force, the last item frequently must be ruled out and justification made on the basis of the first two only. Installation of material that will outlast the remainder of the equipment and have no recovery value must also be avoided; this is particularly important in temporary construction or in old equipment that will soon become obsolete.

In deciding what materials shall be used in a given "hot spot" the engineer will need to make tests that will disclose the right material for the purpose. The authors have laid out a general outline of procedure and have added an invaluable set of tables showing the characteristics of a large series of metals and alloys, together with the results of past tests under the most varied conditions. (Every designer of refinery equipment should at all times have these tables within easy reach. ED.)

How such tests assist in selecting resistant materials is visualized in the accompanying figure, which shows two test racks containing plates of the same eight metals; the rack on the left was exposed 76 days in straight run naphtha, the one on the right 78 days in re-run, acid-treated naphtha.

RECOVERY OF OIL FROM ATHABASKA OIL SANDS.—J. M. McClave, in CANADIAN MINING JOUR., August, 1935, pp. 317–323.

The oil sands or so-called "tar sands" of Northern Alberta contain from four to ten times as much oil as all the known oil fields of the earth taken together. The Dominion Mines Branch estimates the oil content of the Alberta oil sands at some 100,000,000,000 bbl., whereas the U. S. Bureau of Mines estimates it at some 250,000,000,000 bbl. According to the U. S. Geological Survey the proven reserves of all the oil fields of the world are less than 25,000,000,000 bbl.

This paper is a detailed account of the work started in 1919 to develop a process for economical separation of the oil from the sand. These efforts continued without satisfactory results up to 1934, when a process was finally evolved of sufficient practicality to warrant plans for erection of a full sized commercial unit.

The process as finally worked out consists in pugging the sand in water that has been made slightly alkaline with a small amount of sodium silicate, adding enough 300–400 naphtha to dissolve the oil (which is heavy and viscous), separating the oil solution from the sand (using an Atkins or similar classifier), and running the solution to a topping plant to recover the solvent for reuse. The residual oil will then be sent to the cracking stills at a central refinery.

The oil content of the sands is about 15 percent, so that there will be 85 percent of tailings. In a stationary plant, disposal of these tailings would constitute an enormous problem; but this will be overcome by constructing a number of small extraction plants that can be moved along the face of open cuts from which the oil sand is lifted by bucket excavators.

WELDED PRESSURE VESSELS.—R. K. Hopkins, in METALS TECHNOLOGY, August, 1935, I. P. 640.

In an oil refinery the vessels used to contain the various products must often operate at extremely high temperatures (up to 1,000° F.) and on the other hand at sub-zero temperatures (down to −75° F.). In addition, vessels are required that will withstand the attack of very corrosive substances. Further, some vessels must withstand pressures upwards of 1,000 lbs. per square inch and as low as a 29 inch vacuum.

In order to meet the refiner's requirements for this wide range of conditions the fabricator must work hand in hand with the metallurgist. How the metallurgist is prepared to hold up his end of this collaboration is set forth in this paper, which shows what can be done with modern metals, particularly the nickel steels.

Petroleum Physics

VISCOSITY DETERMINATION BY THE AIR BUBBLE METHOD.—John R. Kruska, in OIL & GAS JOUR., vol. 34 (1935), No. 15, p. 50.

The use of the Steiner viscosimeter is explained. This instrument measures the time required for a bubble of air to rise a certain distance through a column of the oil under examination. The results are readily reducible to absolute units (centistokes). The degree of precision is about 0.5 percent for skilled laboratory men.

Viscosity measurements in absolute units are much more informative than in the wholly empirical units of the Saybolt, Engler and similar instruments. The absolute data enable the oil chemist to draw the entire temperature-viscosity curve by making only two determinations. The slope of the resulting curve serves as a means of differentiating various grades of lubricants, the angle of slope being directly dependent on the chemical composition of the oil. Thus, oils with a paraffinous base show a smaller degree of change in kinematic viscosity at various temperatures,

whereas oils of an asphalt base are invariably characterized by steeper viscosity-temperature curves. A further advantage of the kinematic method is that viscosity measurements may be made on heavy oils diluted with more volatile fluids such as gasoline; the resulting viscosity-temperature curves in most cases have the same angle of slope as the curve of the original oil.

On the Characterization of Hydrocarbons.—Ernst Galle, Rudolf Klatt and Walter Friedel, in PETROLEUM, vol. 31 (1935), No. 36, pp. 1–14.

Up to the present no general method is known for separating the paraffinic from the naphthenic hydrocarbons. The present paper is a contribution toward the use of certain physical methods (fluorescence, crystallization, solubility) as more or less practicable means of identification.

When certain hydrocarbons are dissolved in Chlorex (di-chlor-ethyl ether) they exhibit fluoresence and display characteristic colors when examined in ultraviolet light, especially after the hydrocarbons have been treated with concentrated sulphuric acid.

When most pure hydrocarbons are strongly cooled they crystallize in their characteristic forms and thus may be identified. The two methods above mentioned are more or less uncertain when applied to mixtures.

Taking hexane as a representative of the saturated paraffins, amylene as representing the unsaturated series, cyclo-hexane as representing the naphthenes, and benzol as representing the aromatics, the following solubility relations are established:

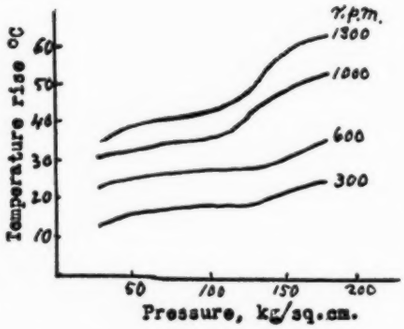
At ordinary temperatures all these hydrocarbons are soluble in Chlorex in any proportion, but when sufficiently cooled there is a separation into two layers; hexane is found in the upper layer, amylene remains in solution; at very low temperatures (−80° C.) benzol and cyclo-hexane crystallize out. Where, hexane, cyclo-hexane and benzol are present it is chiefly the benzol that goes into solution in the Chlorex.

The general conclusion is that Chlorex is well adapted to effect a separation of the paraffinic and naphthenic hydrocarbons from the aromatic and unsaturated hydrocarbons, but is not adapted to separate the paraffins and the naphthenes.

The distribution of the Chlorex in the two layers can readily be estimated by saponification with 4-normal alcoholic potash and titration of the resulting chloride by Mohr's methods.

Pressure Resistance of Lubricating Oils.—Theodor Rabinovitch, in PETROLEUM, vol. 31 (1935), No. 28, pp. 9–14; No. 33, pp. 4–8.

The specific object of this research was to study the difference in the behaviors of lubricating oils of the same viscosity characters, and especially the values of the "critical loads" and the corresponding bearing temperatures; also to explore the boundary between "liquid" and "semi-liquid" friction. The apparatus used corresponded to the testing stand of Kammerer and Welter, which was provided with means for measuring the bearing load, revolutions per minute, temperature and dynamic work; also an electric circuit between bearing and shaft for indicating friction conditions. Two oils, both refined in Germany from American crudes, were used in the tests, which extended over a period of five months. The pertinent results are summarized in the accompanying diagram.



In this diagram the loads on the machine, expressed in kg./sq. cm., are shown on the horizontal axis, and the corresponding rise of temperature of the bearing is known on the vertical axis. The four curves shown on the diagram represent data obtained at different speeds of revolution.

These curves in all cases show that at first the bearing temperatures rise slowly with increase of load, but that at about 125 kg./sq. cm. the bearing temperature increases more rapidly. This knick in the curves is due to the fact that at such loads the oil film is more or less completely broken, or, as the author expresses it, the lubricant passes from the semi-liquid to the liquid condition and allows the two bearing surfaces to come into more or less immediate contact. This critical point is further indicated by the increased amount of current that passes through the circuit that includes the bearing and the shaft. Both oils gave practically identical results.

Petroleum Chemistry

Le Traitement Thermique des Hydrocarbures Gaseux. (The Thermal Treatment of Gaseous Hydrocarbons).—By A. E. Dunstan, E. N. Hague and D. A. Howes. CHIMIE ET INDUSTRIE, vol. 34, 1935, No. 2, pp. 273–276.

The authors report a series of investigations carried out in an effort to convert pure paraffin hydrocarbons, above hexane, into aromatics and into unsaturates with the view of polymerizing and condensing these into liquid products. Three sets of investigations were carried out, namely:

1. Pyrolysis for the production of aromatic motor fuels.
2. Pyrolysis for the production of olefines.
3. Polymerization and condensation of unsaturates for the production of motor fuels.

Temperatures from 825° for hexane to 1,050° C. for methane were utilized, the former yielding 33.8 percent by weight and the latter 8.8 percent by weight of aromatics. The polymerization of ethylene was carried out from 28.1 kg. cm 2 to 112.5 kg. cm 2 and from 510° to 415° C. respectively. Various linings such as copper, aluminum, 18–8 stainless steel were employed in the autoclaves and also in the reaction chamber of a continuous system. These lining surfaces had a pronounced effect on the reaction and yields.

The liquid products from the polymerization of ethylene were predominantly unsaturated and boiled between 36° C. and 208° C. with 98 percent distilling over. The octane value of the product was 73 by the C.F.R. motor method.

Improved Method of Examining Mineral Oils.—J. C. Vlugter, H. I. Waterman and H. A. von Westen, in JOUR. INST. PETROLEUM TECHNOLOGISTS, vol. 21 (1935), No. 142, pp. 701–708.

The authors here continue their research on a new method for the analysis of oils of high molecular weight and high boiling point. The method is based on a complete non-destructive hydrogenization of the oil to be examined.

As a means for controlling the absence of aromatic rings in the hydrogenated product the specific dispersion is used. This is defined as the difference between two refractive indices determined at different wave lengths of the light, divided by the specific gravity. This test will indicate the presence of aromatic compounds when ordinary treatment with sulphuric acid does not show this.

Determination of Bromine and Iodine Numbers of Lubricating Oils.—Ethil E. Casimir and M. Dimitriu, in PETROLEUM, vol. 31 (1935), No. 33, pp. 1–4.

The fact is often overlooked that when the bromine or iodine number of a mineral oil is determined there is frequently a substitution of halogen as well as an addition, and hence the results will be erroneous. To obviate this error the authors recommend the following: Avoid a large excess of the halogen (50 to 70 percent of the usual amount); short time of reaction (15 to 30 minutes); work in the dark and at a low temperature; the titration of the iodine corresponding to the hydrobromic acid must be done immediately after addition of the iodate solution, and the titration interrupted after the point has been reached where the first decoloration persists for a few seconds.

Synthesis from Natural Gas Hydrocarbons.—H. B. Haas, E. T. McBee and Paul Weber, in IND. ENG. CHEM., vol. 27 (1935), No. 10, pp. 1190–1195.

The great industrial importance of the chlorination reactions of the simpler paraffins is evident from the fact that they are serving for the commercial production of amyl alcohols, amyl acetates, amyl xanthates, sulfides and mercaptans, *tert*-amyl-phenol-formaldehyde resins, caproic acid, and a host of other organic chemicals. Several other important applications of these reactions, for example the production of the important new anesthetic, cyclopropane, are at present in the development stage and it is evident that only a start has been made in their utilization.

In spite of the great technical interest in these reactions, the literature concerning them contains many erroneous data.

Most of the articles on the chlorination of the paraffins of three to five carbon atoms con-

tain serious errors. Very little published work in this field can be relied upon for correct information as to such fundamental questions as identity of products and ratios of isomers. The pertinent literature abounds in incorrect physical constants and false identifications.

Uninterrupted research since early in 1929 in the authors' laboratory has yielded results which are now reasonably complete and mutually consistent. In no case has any evidence appeared of a carbon skeleton rearrangement during thermal or photo-chemical chlorination. In every case all of the theoretically possible isomeric monochlorides obtainable without such rearrangement have been found. These generalizations extend to the polychlorides as far as this work has gone.

Use of Petroleum

Reclamation of Lubricating Oils.—R. B. Walker, in REFINER, vol. 14 (1935), No. 9, pp. 446–447.

The United States Government maintains at Duncan Field, near San Antonio, a plant for reclaiming annually from 50,000 to 60,000 gal. of aviation lubricating oil. The process is quite simple. The used oil is settled to remove as much as possible of the grit, water, etc. and heated to drive off gasoline and other volatile matters. It is then run through a series of four filtering pads and blended, if necessary, to obtain the specified viscosity. Recoveries are between 85 and 90 percent and the cost from 9 to 10 cents a gallon. The reclaimed oil does not have the bright green color of new lubricating oils; it is possible by washing and chemical treatment to restore the color, but this is regarded as a needless expense.

The Superiority of Cracked Fuel Oil.—Gustav Egloff, in REFINER, vol. 14 (1935), No. 8, pp. 373–377.

Cracked fuel oil, formerly under suspicion and subject to a price penalty, is now finding an ever widening market—even a preferred market—as its superiority is coming to be better understood. The first and most important advantage of cracked fuel oil is that it contains more B.T.U. to the barrel than straight-run fuel oil. This means that where prices are equal the buyer of cracked fuel gets more heat units for his fuel dollar. Taking an average range of crudes from all the principal oil fields of the United States, it is found that cracked fuels contain 153,400 B.T.U. per gallon, as against 147,300 B.T.U. for straight run fuels. At the same price, therefore, the cracked fuels represent a saving of approximately four percent. As regards coal and oil in firing locomotive boilers, there is a cost differential in favor of coal which, however, is wiped out by other circumstances which give coal a relatively lower economic value.

Another advantage of cracked fuel oil in comparison with the straight run product is that it has a lower pour point, which is of importance in cold climates. With this lowered pour point goes a lower viscosity and a better viscosity-temperature curve. Not to be overlooked is the saving in bunker space for the same heat content. In spite of these advantages, some railroads still exclude cracked fuel oil from their specifications, just as motor fuel users were accustomed in past times to exclude cracked gasoline. The U. S. Navy, a most careful buyer, is one of the large users of cracked fuel oil.

The greater heat content of cracked fuel is due to the fact that it is heavier than straight run fuels, so that its colorific value per gallon is higher.

Influence of Engine Design on Oil Consumption.—M. O. Teetor, before Am. Soc. Testing Materials, Detroit meeting, 1935.

In discussing the question of what becomes of auto oil the author observes that the oil in an automobile engine has three ways to escape. It can leak out where shafts project through the crankcase or because of faulty gaskets or packing; it can be drawn into the combustion chambers past the intake valve guides; or it can pass the pistons into the combustion chambers.

Although it is recognized that oil can leak out of the crankcase, and that it does pass the intake valve guides, the most attention given the subject of oil consumption has been centered on the amount of oil passing the pistons into the combustion chamber. Oil lost on the road does not cause trouble. It just costs money. Oil that passes the intake-valve guides causes little or no trouble but costs money. Excessive amounts of oil passing the pistons cause plenty of trouble and cost plenty of money in terms of oil, maintenance and the life of the engine.

The reasonable solution seems to be in improvements in engine design that will eliminate unfavorable factors affecting the performance of piston rings.

Underwater Bituminous Paints.—E. Kindscher, in OEL UND KOHLE, vol. 11 (1935), No. 36, pp. 669–672.

The best paints for protecting iron under water are those with a bituminous base mixed with a little natural asphalt and some inorganic filler. Such fillers, however, should on no account be of such a nature that they can absorb water and swell up; this excludes clay and clayey materials. There are two methods, the hot and the cold, for applying the paints; in the cold method the base is dissolved or thinned with benzol or benzine, the thinner being allowed to evaporate before the pipe is submerged. This drying process requires too much time and it is preferable to apply the melted, hot bitumen direct on the cleaned pipe in a layer one-eighth or one quarter inch thick. When skillfully applied by experienced workmen such a coat should last for years even in sea water. For extra good adhesion it is advisable to apply a very thin precoat by the cold method before putting on the thicker hot coat.

Two Studies in Relative Film Strength of Motor Lubricants.—By W. M. Irish; published 1935 by Atlantic Refining Co.

This booklet, in mimeograph, with extensive tables and photographic illustrations, contains the results of a series of 3,653 tests made on the Almen machine with 154 different brands of motor lubricating oils; 34 of these oils broke down and allowed the moving parts of the motor to touch at an average pressure of 4,945 lbs. per square inch. On the same machine some recently developed high strength lubricants were able to withstand pressures of more than 14,000 lbs. per square inch.

In addition to these tests with the Almen machine, a battery of six automobile engines mounted on blocks and connected with a water dynamometer for load purposes was used to test motor oils under operating conditions. After running the equivalent of 200,000 miles the motors were torn down and measured to determine cylinder wear and ring gap increase. The cylinders of motors run on high film strength oil showed 33.3 percent less wear than those lubricated with regular oil, while there was an average difference of 40 percent in ring gap increase.

Petroleum Substitutes

Fuels of the Future.—Sir H. McGowan, in JOUR. SOC. CHEM. IND., vol. 53 (1935), p. 969.

In this address the author considers how the coal industry, which has severely felt competition from petroleum products, particularly fuel oil, might retrieve something of its former position. One hopeful prospect is found in recent improvements on the coal-dust motor. Beyond this is the fact that the manufacture of oil by hydrogenizing coal has made great progress in England and elsewhere, and it is hoped that, in England at least, coal will be able to compete with petroleum.

Development of Hydrogenization in Italy.—M. G. Levi and C. Padovani, in REV. ITAL. PETROLIO, vol. 3 (1935), No. 7, pp. 4–8.

Investigations have shown that the lignites of Tuscany can be hydrogenized with a direct yield of about 15 percent of good gasoline and 30 percent of total liquid oil. On this basis it is calculated that an annual throughput of two million tons of this lignite would yield between 300,000 and 400,000 tons of gasoline. Still higher yields may be obtained from the Arsa coals. Considerable supplies might also be obtained from the Albanian asphaltic oils.

The Coal-Dust Motor.—H. Wahl, in OEL UND KOHLE, vol. 11 (1935), No. 36, pp. 691–693.

The author notes that, beginning with MacCallum, three generations of engineers have worked on the problem of producing energy by burning coal directly in a motor. Diesel tried powdered coal before he turned his attention to oil. Efforts to solve this problem have been particularly intensive in Germany, and according to the author success is now assured.

The two greatest problems that had to be overcome are the matter of introducing the powdered coal into the combustion chamber, and the problem of wear on the cylinders and pistons by the abrasive action of the ash. The grinding of the coal presents no difficulty; all that is required is that the coal be fine enough to leave no more than two or three percent on a No. 100 sieve. Introduction of the coal into the combustion chamber, which

must be accomplished within a few hundredths of a second against a back-pressure of 30 kg. per square centimeter, is effected by the preheated air injected for combustion.

Next is the problem of wear on the working surfaces. In 2,000 hrs. operation in a machine with 90 liters cylinder capacity, using brown coal of six percent ash content, no less than 6,000 kg. (3 tons) of ash passes through the engine. Ordinary steel is soon worn down. Chrom-nickel cast iron is not resistant enough, but the Schichau firm is credited with production of a particularly hard steel of such resistance that a coal dust motor burning coal of seven percent ash content shows hardly any more wear than an ordinary Diesel engine. Experience at Oppau has so far shown that a thermal efficiency of up to 31.5 percent can be attained at full load.

It is not claimed that all details have been perfected, but it is expected that these will be cleared up shortly.

Petroleum Economics

INCREASE IN WORLD CRUDE OIL PRODUCTION.—Oskar Tokayer, in PETROL. PRESS SERVICE, vol. 2 (1935), No. 15, pp. 6–7.

The increase in the production of oil, which was noticeable in most of the producing countries in the course of last year, further continued in the first half of 1935 and, in some cases, was intensified. Of the larger producing countries, United States, Iraq, Venezuela and Iran in particular showed striking increases, while Roumanian production progressed only slightly and Russia showed a decline.

According to estimates based in most cases on official figures, the world crude oil production during the first six months of 1935 amounted to 782,548,000 bbl., as against 736,750,000 bbl. for the corresponding period of last year; i.e. an increase of 6.2 percent. The most interesting feature of these returns is the swift rise in the output of Iraq, which at one bound has assumed eighth place among oil producing countries.

The increase of about 24,020,000 bbl. in the American crude oil production during the first half of 1935, although considerable in itself, has not had a detrimental influence on the market, partly because of the decline in the quantity of illegally produced crude oil, but mainly owing to the materially larger consumption in U. S. A. and to the greater world demand for petroleum products.

The huge jump in the output of the Iraq fields was the result of the opening of the pipeline to the Mediterranean. As this is entirely additional production it might be feared that a new disturbing factor had made its appearance in the already serious problem of world overproduction. This, however, is not the case, as the control of Iraq crude oil is in strong hands and in practice it may be safely assumed that this increased production is, to a great extent, being set off by correspondingly stricter limitation of production elsewhere. In short, crude oil production in the remaining countries would have increased still more if the development in Iraq had not taken place and American crude exports would also have been correspondingly greater. On the other hand, the further decline of Russian oil exports has greatly facilitated the task of offsetting any unfavorable effects of Iraq petroleum on the international market situation.

The rather considerable increase in German crude oil production, although of minor importance so far as the world market is concerned, is interesting since, if it continues, Germany's output should before long exceed that of Poland, whose crude oil production is steadily declining.

ROAD AND RAIL COORDINATION.—Oskar Tokayer, in PETROL. PRESS SERVICE, vol. 2 (1935), No. 15, pp. 1–3.

At the meeting held by the International Chamber of Commerce in Paris at the end of June, one of the main topics of discussion was the thorny subject of competition between the railways and road transport. There was, as usual, the widest divergence of opinion between those who believe in allowing transport facilities to develop with demand and those who believe that development must be regulated, especially with the object of assisting the railways. The uncompromising attitude sometimes adopted by the railways was not in evidence at this I. C. C. meeting. Indeed, efforts were made to find a common basis which would enable both parties to cooperate to their mutual satisfaction. The general opinion was that the system of unregulated competition which has arisen during the first phase of goods traffic on the road cannot be allowed to continue indefinitely. Judging from the short papers read at the meeting as well as from the mass of material produced in discussions and memoranda, it can be stated that the representatives of motor transport were willing to accept the railways' claim to impose on road transport obligations equivalent to the railways' liabilities as to indemnity, publication of tariffs, regularity of services, uniform treatment of all customers, etc. On the other hand, the railways' representatives abstained from demanding the restrictive taxation of road transport. Both sides were agreed that the railways should be free to abandon unprofitable lines and there was general agreement as to the necessity for the retention of some form of tariff which would be considered desirable from the traders' point of view. Any fundamental change in the present railway freight system was therefore considered undesirable, although it was admitted that there was a case to be made for more elastic tariffs based upon economic, rather than upon purely revenue, considerations.

REFINING TRENDS.—W. T. Ziegenhain, in OIL AND GAS JOUR., vol. 34 (1935), No. 10, pp. 42–43.

A survey of important new items in refinery construction within recent months indicates three important trends. One is the expansion of foreign refining operations and the ready acceptance of modern American practices. Another is the general replacement of the conventional skimming and cracking equipment with combination units. The third is the general use of solvents for refining and dewaxing lubricants. Foreign developments are especially striking; 35,000 bbl. daily capacity was added a year ago and more than that is under construction now. Practically all the crude for these new plants comes from Venezuela, replacing American sources.

At the present time combination units are being built to handle 35,000 bbl. of crude per day. While this tabulation of recent work summarizes the trend in refining it gives little suggestion of the next major development for which refiners are preparing. They anticipate the general adoption of gas polymerization. Instead of separating the oil and gas, both will be piped to the refinery direct from the well, where ethane, propane, butane and the higher hydrocarbons will all be converted into motor fuels of 80 to 90 octane value; there will be no need of processing through a gasoline plant.

Books

VISCOSIMETRY (Zur Viscosimetrie) with an Appendix: International Tables.—by Prof. Dr. L. Ubbelohde, published 1935 by Verlag Mineraloelforschung, Berlin, Germany; 42 pp.; 9.50 Reichmarks.

The well known author, who has heretofore distinguished himself in the special field of the viscosimetry of oils, has now produced a new small volume which will be a convenience to all oil chemists. The temperature relations of viscosity come in for especial attention, and formulae are given by which the whole temperature-viscosity relations of an oil can be determined from measurements at two temperatures.

A full description is given of the author's hanging drop viscosimeter, in which may be placed, without measuring, a small quantity of oil and the absolute viscosity read directly in centipoises with an accuracy of 0.1 percent. The Appendix contains tables giving, in parallel columns, the values for kinematic viscosity, Engler degrees, Saybolt seconds and Redwood seconds. It is a hand book that can be recommended.

THE CRACKING ART IN 1934.—by Gustav Egloff and Emma E. Crandal; published 1935 by Universal Oil Products Co., Chicago; 196 pages.

This report covers publications on the cracking of petroleum products that have appeared between December 1, 1933 and January 1, 1935, and includes both journal and patent literature.

The work is divided into 16 chapters, described as follows: Introduction, status of cracking, economics of cracking, cracking outside the United States, liquid phase cracking (catalytic and non-catalytic), vapor phase cracking (catalytic and non-catalytic), combination liquid-vapor and vapor-phase cracking, cracking with oxidation, electrical cracking, combination of operation, combination cracking and treating, treating cracked products, by products of cracking, cracking equipment (apparatus and corrosion) and reviews of cracking.

Under the head of "treating cracked products" are reviewed publications on the use of acid, adsorbents, alkali, heat and/or pressure, inhibitors, metals, oxides, oxygen, salts and miscellaneous.

The book contains 144 journal references and digests of several hundred patents taken out in nearly all countries.

World Oil Production—Official Figures for 1934 and 1935 Revised

All figures furnished direct to WORLD PETROLEUM by Governments, except where otherwise specified

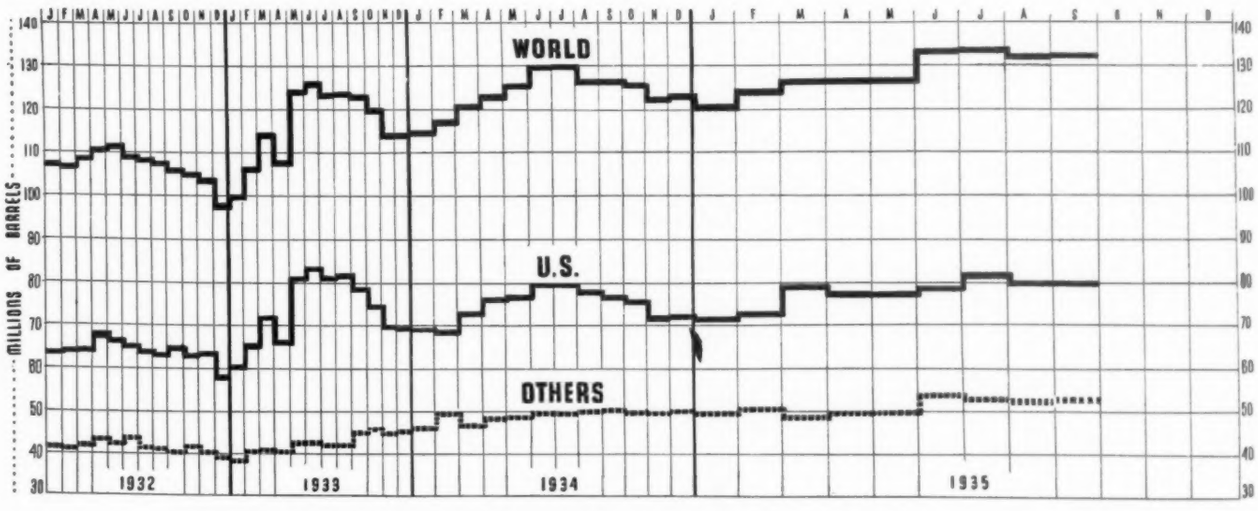
(Figures in U. S. Barrels—Conversion ratio 7 bbl. = 1 ton)

Country	October 1934	November 1934	December 1934	January 1935	February 1935	March 1935	April 1935	May 1935	June 1935	July 1935	August 1935	Provisional Figures September 1935
United States	76,776,000	72,463,000	74,772,000	78,715,000	72,763,000	81,488,000	78,427,000	82,454,000	82,338,000	85,485,000	84,816,000	82,080,000
Russia	14,260,000	14,388,500	14,638,400	13,358,000	12,704,300	14,139,300	14,058,200	15,248,800	14,232,400	14,050,000	14,230,000	14,318,000
Venezuela	12,591,390	12,274,794	12,420,296	12,818,414	11,287,605	11,703,825	11,869,900	12,175,022	13,075,118	13,429,885	12,628,067[1]	13,151,362
Iraq[5]	12,006,127	11,618,510	12,006,127	425,000	1,631,000	2,258,123	556,500[1]	1,085,000[1]	4,200,000[1]	1,739,348[1]	1,739,255[1]	1,683,240
Roumania	5,467,000	5,324,000	5,522,000	5,355,000	4,860,000	5,256,000	5,008,000	5,035,000	4,842,000	5,075,000	5,030,000	5,017,800
Iran[3]	4,499,530	3,725,178	4,049,556	4,410,714	4,109,665	4,879,000	4,088,000	3,927,000	4,200,000	4,249,000	4,634,000	4,270,000
Mexico	3,393,770	3,332,926	3,425,314	2,894,167	2,661,632	3,519,148	3,120,035	3,529,659	3,453,871	3,573,632	3,570,908	3,445,725
Netherland India	3,577,399	3,553,067	3,743,810	3,618,272	3,244,717	3,539,564	3,438,848	3,517,360	3,463,061	3,531,857	3,699,430	3,463,350
Colombia[4]	1,646,293	1,633,654	1,554,172	1,653,647	1,141,696	1,466,821	1,377,299	1,486,896	1,518,460	1,639,054	1,567,307	1,555,676
Argentina	1,271,186	1,283,811	1,173,998	1,114,235	1,107,420	1,260,468	1,514,968	1,203,017	1,161,638	1,198,550	1,263,994[1]	1,206,690
Peru[6]	1,485,309	1,340,115	1,420,247	1,418,320	1,269,077	1,395,532	1,329,215	1,451,436	1,414,588	1,448,225	1,442,565	1,448,133
Trinidad	906,152	907,655	930,877	915,220	843,619	919,848	899,946	953,108	972,904	988,341	1,003,382	992,445
British India	779,011	763,091	746,410	781,170	708,159	773,572	756,461	794,968	768,692	700,000[1]	700,000[1]	711,360
Poland	315,000	308,000	308,000	307,000[1]	297,000[1]	309,000[1]	330,000[1]	340,000[1]	314,490[1]	324,973[1]	274,040[1]	308,220
Brunei	225,561	227,815	258,909	269,794	241,927	264,390	267,603	277,550	269,290	283,430	281,400	256,480
Sarawak	156,800	152,600	158,200	183,300	136,500	152,250	151,067	155,400	150,850	151,830	154,000	145,600
Japan	125,229	119,970	131,059	171,441	151,797	164,174	167,728	154,150	144,160[1]	146,863	152,290	157,738
Egypt	123,235	116,326	115,731	112,147	100,086	104,419	94,955	100,535	99,260	103,488	104,937	100,954
Ecuador	141,079	133,490	140,000	147,315	139,555	151,366	145,212	147,245	137,806	144,812	135,549	138,986
Canada	122,056	113,228	117,113	124,654	111,545	120,537	108,506	122,636[1]	120,102	118,812	117,652	116,880
Germany[2]	227,605	219,485	228,767	287,518	223,153	277,942	240,464	285,747	257,369	276,990	241,801	257,370
France	46,000[1]	46,000[1]	46,000[1]	43,078	34,510	44,191	46,284	46,991	46,000[1]	45,276	46,312	43,530
Others[1]	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000	75,000
Total	140,216,732	134,120,215	137,981,986	129,198,406	119,842,963	134,262,470	128,071,191	134,566,540	137,255,059	137,779,866	137,907,889	132,338,799

[1] Estimate. [2] Anglo-Persian Oil Co. figures revised; fuel oil returned to the ground has been deducted. [3] Thuringia estimated 7,000 bbl.; official figure for Prussia. Russian Sakhalin included with Russia. Japanese Sakhalin included with Japan. [4] International Petroleum Company's figures. [5] Iraq production estimated for 1934 on basis of total year's production represented by oil shipments through Tripoli and Haifa starting January 1935 plus oil necessary to fill line initially. [6] International Petroleum Company and Lobitos Oilfields Ltd. figures.

Official Crude Oil Production for 1932 to 1935

Country	Total 1935 to September 30	Daily Average 1935 to September 30	Total 1934	Daily Average 1934	Total 1933	Daily Average 1933	Total 1932	Daily Average 1932
United States	725,960,260	2,659,195	909,107,000	2,490,704	898,874,000	2,462,670	785,159,000	2,145,243
Russia	126,339,000	462,780	168,648,700	462,051	149,901,900	407,950	149,719,000	409,070
Venezuela	112,139,198	410,766	142,072,329	389,239	120,882,802	331,186	119,596,512	326,766
Iraq	15,317,466	56,108	71,921,468	6,607	1,200,000	3,288	1,200,000	3,300
Roumania	45,478,800	166,589	62,006,000	169,879	50,971,200	139,647	50,491,205	137,954
Iran	38,767,379	142,005	52,663,782	144,284	49,581,280	135,840	45,122,455	123,285
Mexico	29,768,777	109,043	38,167,022	104,567	33,904,882	92,890	32,802,285	89,624
Netherland India	31,516,459	115,445	42,289,408	115,861	38,512,663	105,516	39,584,027	108,153
Colombia	13,406,856	49,109	17,340,724	47,509	13,157,127	36,047	16,384,956	44,768
Argentina	11,030,980	40,407	14,045,652	39,015	13,759,565	38,232	13,166,900	35,975
Peru	12,617,091	46,216	15,936,937	43,663	13,923,281 −	38,146	9,899,266	26,026
Trinidad	8,488,813	31,095	10,894,363	29,847	9,560,039	26,192	10,023,780	27,387
British India	6,694,382	24,522	8,997,399	24,650	8,721,655 +	23,893	8,600,312	23,500
Poland	2,804,723	10,274	3,697,617	10,130	3,858,085 −	10,570	3,905,230	10,670
Brunei	2,411,864	8,835	2,673,041	7,323				
Sarawak	1,380,797	5,058	1,948,044	5,337	2,289,472 −	6,273	2,274,043	6,213
Japan	1,410,341	5,166	1,484,962	4,068	1,377,761	3,827	1,575,333	4,375
Egypt	920,801	3,373	1,479,037	4,052	1,591,495	4,360	1,742,370	4,760
Ecuador	1,287,846	4,717	1,655,062	4,534	1,622,624 −	4,446	1,573,857	4,300
Canada	1,061,324	3,888	1,418,810	3,887	1,147,825 −	3,144	1,054,373	2,880
Germany	2,348,354	8,602	2,266,964	6,211	1,712,823	4,692	1,824,019	4,983
France	396,172	1,451	552,000	1,512	552,000	1,515	552,000	1,508
Bahrein			285,071	781				
Others	675,000	2,473	861,000	2,359	432,000	1,184	432,000	1,180
	1,192,222,683	4,367,117	1,502,617,452	4,117,293	1,417,534,489	3,884,022	1,296,712,823	3,544,940



World crude oil production trend by months, 1932–1935. Chart is weighted to compensate for variation in number of days per month. Ratio of U. S. crude production to world production.

MEXICO

SUGGESTIONS of the "open door" policy for the exploitation of petroleum to permit immediate working of federal oil reserves on a large scale as a means of increasing the government's and the nation's wealth, made to the ministry of national economy by Engineer Guillermo A. Alonso, president of the National Association of Petroleum Men (an organization distinct from the Association of Petroleum Producers), cannot be put into effect, Gen. Rafael Sanchez Tapia, Ministry of Economy, asserts. Federal government cannot permit large scale exploitation of petroleum, he declares, and must protect national natural resources by creating oil reserves, for oil resources are not unlimited, as has been proven in several zones of Mexico.

A Tampico district court rejected suit of Mexican Eagle Oil Co. (Royal Dutch Shell) for an injunction against execution of Ministry of National Economy's ruling that its wells, Zacamixtle Nos. 29 and 35, in the Tampico sector, be expropriated, on the ground that they are "nationalizable" and given to Cia. Petroleos de Mexico, S.A. (PETROMEX, S.A.) Court held that Mexican Eagle had not clearly proven its rights to the wells which it took over from its sister enterprise, Holland Crown Oil Co. Eagle's suit for an injunction to restrain the government from executing its decision to use Eagle's pipeline from Palma Sola, Vera Cruz state, to its refinery at Azcapotzalco, near Mexico City, to move oil to Mexico City from the expropriated wells for PETROMEX, was also rejected by the tribunal, which held that federal petroleum laws demand that private oleoducts can be used for transportation of nationally owned oil.

Mexican Eagle Oil Co. denies a press association story to the effect that its refinery at Minatitlan, Vera Cruz state, is working overtime to fill orders from the British Admiralty for fuel for the British Mediterranean fleet with the statement that the refinery is working normally and there are no prospects for any unusually large shipments from it. Refinery's program has experienced no important modification in the past 12 months, the statement avers. Company explains that for some time most of its embarkations of petroleum combustible have been made at Minatitlan instead of Tampico as most of this fuel produced in the Tampico zone is required to fill contracts with the National Railways of Mexico and to supply the domestic market.

Moves by some union workers of its Agua Dulce unit, Vera Cruz state, to induce the federal government to order the expulsion from Mexico of four Britishers who are high officials of the company, on the ground that they allegedly dismissed 46 employees without justification, are answered by a statement by Mexican Eagle that no employees of the unit have been dismissed and that nearly 100 of them are being retained on the payroll, although they do little if any work.

Huasteca Petroleum Co. (Standard of New Jersey) has obtained an injunction from a Mexico City court against enforcement of a ruling of the federal Board of Arbitration and Conciliation that it must establish a 42-hour week at its Mata Redonda refinery, Vera Cruz state, and pay workers of the plant, sick from non-professional diseases, full wages during their disability.

Ministry of National Economy announces bringing in of well Rincon No. 22 in the Chapacao zone, Vera Cruz, at 1,410 ft. and with an initial daily production of 296 bbl.

Negotiations for a quantity of Mexican petroleum being conducted by Pedro Guati, Italian business man, are not in behalf of the Mussolini government but for private Italian interests, Confederation of Mexican Chambers of Commerce announces.

Reduction of the gasoline price from 20 to 18 centavos a liter has obliged Pierce Oil Co. to abandon, for the present, constructions and installations it contemplated at its Arbol Grande refinery, near Tampico, asserts G. A. Steele, president and general manager.

DOUGLAS GRAHAME

CANADA

Imports

DURING the month of August 1935, Canada imported 126,729,590 gal. of crude, valued at $3,714,858, compared with 129,613,183 gal. valued at $3,837,732 for August 1934. The August 1935 figure shows a drop of 6,921,010 gal. from the July 1935 figure.

Gasoline imports into Canada for August 1935 were 2,720,805 gal., valued at $216,738. This compared with 1,464,776 gal. for August 1934, valued at $138,821, and 2,238,419 gal. for July 1935, valued at $202,917.

The Dominion Bureau of Statistics, Ottawa, in its report of the Petroleum Products Industry in Canada for 1934, states that 42 petroleum refineries were in operation in Canada during 1934, the total capacity being 159,400 bbl. of crude oil per day. Fourteen refineries operated cracking units with a combined capacity of 74,350 bbl. per day.

Oil refineries used, in 1934, a total of 1,109,510,343 gal. of crude oil, of which 770,382,530 gal. were from United States, 297,666,050 gal. from Trinidad and South American countries, and 41,461,763 gal. from Canadian wells.

Gasoline production in 1934 amounted to 461,753,363 gal., of which 166,773,271 were made by cracking and 294,980,092 by straight run. Imports of gasoline during 1934 amount to 61,581,870 gal., which with the production of 461,753,363 gal. and the decline in refinery stocks of 6,050,080 gal., made a total supply of 529,385,313 gal. Exports totalled 4,762,672 gal., leaving 524,622,641 gal. as the apparent consumption in Canada.

Miscellaneous Developments

AMALGAMATED Oils Limited, in the Hudson Bay Junction area, Manitoba, have brought in their fifth well at Kakwa at 206 ft. Gas was encountered 70 ft. nearer the surface than in the wells previously drilled. The latter four wells are approximately 275 ft. deep, and the company's geologist, Mr. W. B. Fry, issued the report that the flow was stronger in the fifth well than in any of the previous ones.

Field surveys sent out by the Canadian Government under Supplementary Public Works Act provisions found that extensive drilling of new gas supplies has more than overcome a shortage that threatened in 1933. Recent geological mapping will call attention to additional areas where drilling is likely to be successful. Geological surveys conducted this season in the natural gas belt of southwestern Ontario disclosed little likelihood of municipalities in that area suffering shortage of supply for several decades.

The Birdtail river district, a few miles north of Rossburn, Manitoba, is the scene of a considerable amount of staking. An inhabitant of this locality dug a well last year, and found the water unfit for drinking as it was covered with a film of oil. This year he dug another well with the same result. A Winnipeg syndicate heard of this and put up stakes on a considerable acreage. Over twenty licenses have so far been issued by the Mining Recorder's office, but no real work has yet been done. Government maps indicate oil shales in the locality.

R. C. ROWE

World Petroleum Books

Petroleum in the United States and Possessions

By Ralph Arnold and Wm. J. Kemnitzer

● All of the salient data of petroleum from the beginning of the industry to the present time. The history, development, and future possibilities of petroleum in the United States and Possessions. Over 1,000 pp. 37 Charts, 91 Full-page tables.....$6.00

Textbook of Petroleum Production Engineering

By Lester C. Uren

● A textbook on the technology of oil field development and petroleum production. 6 x 9 with 657 pp., 348 illustrations...$6.00

Valuation of Oil and Gas Lands

By Robt. W. Brown

● A guide in the commercial valuation for sale or purchase, merger, capitalization and engineering procedure and valuable for taxation purposes under the Federal Income Tax Law. It shows by concrete examples how the various factors affect value and how these factors must be handled in valuation. 215 pp. 6 x 9. 38 illustrations.....$3.00

Oil Economics

By Campbell Osborn

● Gives practical methods of studying values and forecasting prices. Products allied to petroleum products, such as natural-gas and natural-gas gasoline, are also included in this helpful discussion of oil economics. 401 pp. 5 x 8. Illustrated. $4.00

Geology of Petroleum

By Wm. Harvey Emmons

● A textbook and manual of the geology and deposits of oil-bearing areas. Essentially all of the world's oil fields are covered. 435 illustrations, cross sections and Index maps. *Second Edition*. 736 pp. 6 x 9.....$6.00

Shale Oil

By Ralph H. McKee

● Aided by several collaborators, Dr. McKee has brought together such information as will give the reader a correct view of the shale oil industry and the lines along which future development may be expected. 326 pp. Illustrated.....$4.50

Motor Fuels, Their Production and Technology

By Eugene H. Leslie

● A book of interest not only to refinery engineers, research men and automotive engineers, but also to anyone connected with the production and utilization of motor fuels. 581 pp. Illustrated....$11.00

Chemical Refining of Petroleum

By V. Kalichevsky and B. Stagner

● A single volume presenting a comprehensive and practical discussion of the use and effects of the various chemicals and reagents in refining and modifying petroleum and its products. 448 pp. Illustrated.....$7.00

Lubricating Greases

By E. N. Klemgard

● A book of practical and scientific data on the manufacture and use of lubricating greases, including the chemical analysis of many commercial lubricants, abstracts of important patents, and formulas and processes for the manufacture of greases. 198 pp.....$5.50

Recovery of Gasoline from Natural Gas

By George A. Burrell

● Covers the subject thoroughly from the chemical engineering and economic aspects with complete details as to the equipment employed in the industry. Illustrated. 600 pp.....$7.50

Diesel Engine Design

By Harold F. Shepherd

● The only book in the English language which treats completely the design of all parts of the fuel injection apparatus and combustion chambers in Diesel engines. 227 pp.....$3.50

Petroleum Resources of the World

By Valentine R. Garfias

● Fully illustrated with maps, showing producing fields and petroleum indications in the various countries of the world. 243 pp.....$3.00

Oil Well Drilling Methods

By Victor Ziegler

● A brief description and explanation of the tools and methods used in drilling oil wells, intended to serve as an introduction to this subject. 257 pp. Cloth.....$3.00

World Petroleum Directory

● An annual directory of active operating oil companies of the world, showing executive personnel, capital structure and dividend records, extent and location of properties, subsidiary companies, etc. *1936 Edition*.....$10.00

Principles of Motor Fuel Preparation and Application

By Alfred W. Nash and D. A. Howes

● Vol. I deals with the production of motor fuels by methods of distillation, cracking, extraction from natural gas and hydrogenation. It also contains chapters concerning the production of benzole, various synthetic fuels, including alcohols, and general storage and distribution. Vol. I. 538 pp.....$8.00

● Vol. II deals with the properties of motor fuels and covers such subjects as analysis, sulphur contents, gumming properties, volatility requirements and knock ratings, as well as motor fuel and aviation spirit specifications and a chapter on automotive Diesel engines and Diesel fuels. Vol. II. 523 pp.....$8.00

The Chemistry of Petroleum Derivatives

By Carleton Ellis

● A comprehensive work, encyclopedic in scope, which offers a source for up-to-date information for the organic chemists and technologists in the petroleum and related industries as well as all concerned with the development and utilization of natural gas and petroleum and their chemical derivatives. 50 chaps. 1285 pp. Illustrated.....$18.00

Handbook of Butane-Propane Gases

● CONTENTS: Summary of two years' developments; Use in Internal Combustion Engines; Design and Installation of Storage; Supply from Petroleum Refineries; Engineering and Utilization; Economic Comparisons with Coal, Oil, Electricity, Producer Gas, Mfg. Gas; Special Uses; Volume Correction Factors; Supplements and Revisions; Transportation; Use with Other Gases; Analysis and Testing; Properties of Mixtures; Bottled Gas Distribution; Bibliography; Central Plant Directory; Catalogue Section. *Second Edition*.....$5.00

Petroleum World Annual Review

● A detailed compilation of all significant statistics of the California oil industry, including production, refining and sales figures. *1935 Edition*.....$2.00

Petroleum Engineering Handbook

● A handbook of processes, methods and practices in use in the various oil fields and refineries in the United States. Vols. I and II. Price per Vol.....$5.00

U. S. S. R.

Official Figures for Soviet Oil Operations

	Crude Production (bbl.)	Daily Average (bbl.)	Run to Stills (bbl.)	Drilling (feet)
January	13,358,000	430,935	11,400,000	248,672
February	12,704,300	453,725	10,909,500	334,000
March	14,139,300	456,609	11,714,000	449,417
April	14,058,200	468,609	12,052,600	332,843
May	15,248,800	491,897	12,516,000	421,225
June	14,232,400	474,414	12,312,300	474,029
July	14,050,000	453,226	12,315,000	449,750
August	14,230,000	469,032	12,250,000	449,900
September	14,318,000	477,267	12,300,000	448,950
Total 9 Months 1935	126,339,000	464,612	107,004,400	3,607,986
Total 9 Months 1934	125,369,100	459,222	110,068,600	3,195,596
Total 1934	168,648,700	458,042	145,141,000	4,122,898
Quota 1934	214,900,000	588,876	161,000,000	4,950,000
Quota 1935	212,310,000*	581,672	171,500,000	5,214,000

* Revised from 232,400,000

Crude conversion: Seven barrels=one ton

PRODUCTION figures for the first eight months of 1935 show substantial gains over the same period last year in all branches of Soviet heavy industries except oil and gas production. Though crude production does show an increase of 3.5 percent, this is almost negligible when compared with gains in other industries of from 13.3 to 58.8 percent, as shown in the accompanying table.

THE following features of Soviet oil production during September are noteworthy.

All eight cracking units at Saratoff have come on stream and are operating satisfactorily. Six more cracking units are to be erected there.

Vostokneft has been split up into two units, namely, Vostokneft for the exploration of new oil regions in the Eastern regions of the country, and Bashkirneft which will embrace the oil fields of Ishimbayevo. S. Ganshin has been put in charge of Bashkirneft. At present, Ishimbayevo produces 17,500 bbl. of crude per day and several new wells have been brought in at Kuspiakulovo, which is about seven miles from Ishimbayevo. The Ishimbayevo field is being prepared for regular production, gas lines being laid, compressor stations erected and all necessary equipment provided for mechanization of production.

At Uch-Kizil (Uzbekistan) or Turcomanneft (12 miles from Haudag) a gusher was brought in on September 9th, flowing 70,000 bbl. of crude during the first 36 hours. The operators were taken unawares and the flow of crude flooded the neighborhood, including the Termes railroad station. This gusher is similar in force and potentiality to the famous gushers of Lokbatan (Baku), and was temporarily capped for adjustment to normal production.

FOR THE first eight months of this year (January through August) Soviet petroleum exports amounted to 2,136,915 tons of which 322,286 tons went to Germany, 264,799 tons to France, 210,404 tons to Great Britain, 158,084 to Italy and 143,506 tons to Spain. Soviet gasoline exports show a very considerable decrease during the first eight months of this year compared to the corresponding period of last year, the figure for 1935 (January through August) being 439,016 tons against 928,068 tons during 1934.

M. BARINOFF, head of Glavneft, has returned from an inspection trip over the new oil regions in the east of the country and reports:

Scientific research and new methods of geology have established the existence of immense oil resources in the eastern regions of the Soviet Union, particularly in the Emba-Ural districts. The development of Emba is already under way. The average crude production of Emba at present is about 4,200 bbl. per day, and this probably will be increased, as the new field at Koschagil has a potentiality of about 7,000 bbl. per day and South Iskin will produce an equal quantity. These two new fields of Emba are in no way inferior to any of the oil fields of Baku and there is still the assurance that Emba will yield more oil fields of similar potentiality. At Koschagil 13 wells are already completed and four more wells are drilling. As soon as the Caspi-Orsk pipeline is completed this crude will be available.

(Continued on page 702)

Exports of Petroleum Products from U. S. S. R.

(Jan.-July 1935. Figures in Tons)

	Seven Months Jan.-July 1935	1934	Percent increase or decrease
Crude	9,516	133,493	− 92.9
Motor Spirit	405,714	736,213	− 44.9
Kerosene	237,827	241,726	− 1.6
Lubricating Oil (including Transformer Oil)	151,926	150,062	+ 1.2
Fuel and Diesel	787,567	835,198	− 5.7
Gas Oil	288,432	349,949	− 17.6
Asphalt	12,500	21,993	− 43.2
Paraffin Wax	8,693	6,161	+ 41.1
Others	3,383	703	+381.2
Total	1,905,558	2,475,498	− 23.0
Total Without Crude	1,896,042	2,342,005	− 19.0

Exports of Oil Products from U. S. S. R. By Countries

(Seven Months Jan.-July 1935-1934. In Tons)

	1935	1934	Percent increase or decrease
Afghanistan	1,473	1,280	+ 15.1
Belgium	72,917	97,362	− 25.1
British Empire	193,325	291,073	.....
Germany	271,786	270,749	+ .04
Denmark	61,555	59,382	+ 3.7
Iran (Persia)	22,338	16,724	+ 33.6
Spain	129,884	310,704	− 58.2
Italy	137,331	370,907	− 63.0
East China	11,819	40,748	− 71.0
West China	963	418	+130.4
Latvia	4,621	4,795	− 3.6
Lithuania	3,673	5,243	− 28.9
Mongolia	5,563	5,786	− 3.9
Norway	3,577	3,637	− 1.6
Tanu-Tuva	487	430	+ 13.3
Turkey	36,475	9,483	+284.6
South America	8,789	37,058	.....
Finland	11,345	13,016	− 12.8
France	219,011	455,364	− 51.9
Sweden	94,575	110,892	− 14.7
Esthonia	1,911	3,630	− 47.4
Japan	27,753	9,227	+200.8
All Other Countries	584,427	357,590	+ 69.9
Total	1,905,558	2,475,498	− 23.0

SULPHURIC ACID

Recovery, Production, Concentration

New construction and remodeling to meet refinery needs

Chemico Sludge Conversion Plants for recovery of strong clean acid direct from raw unseparated acid sludge

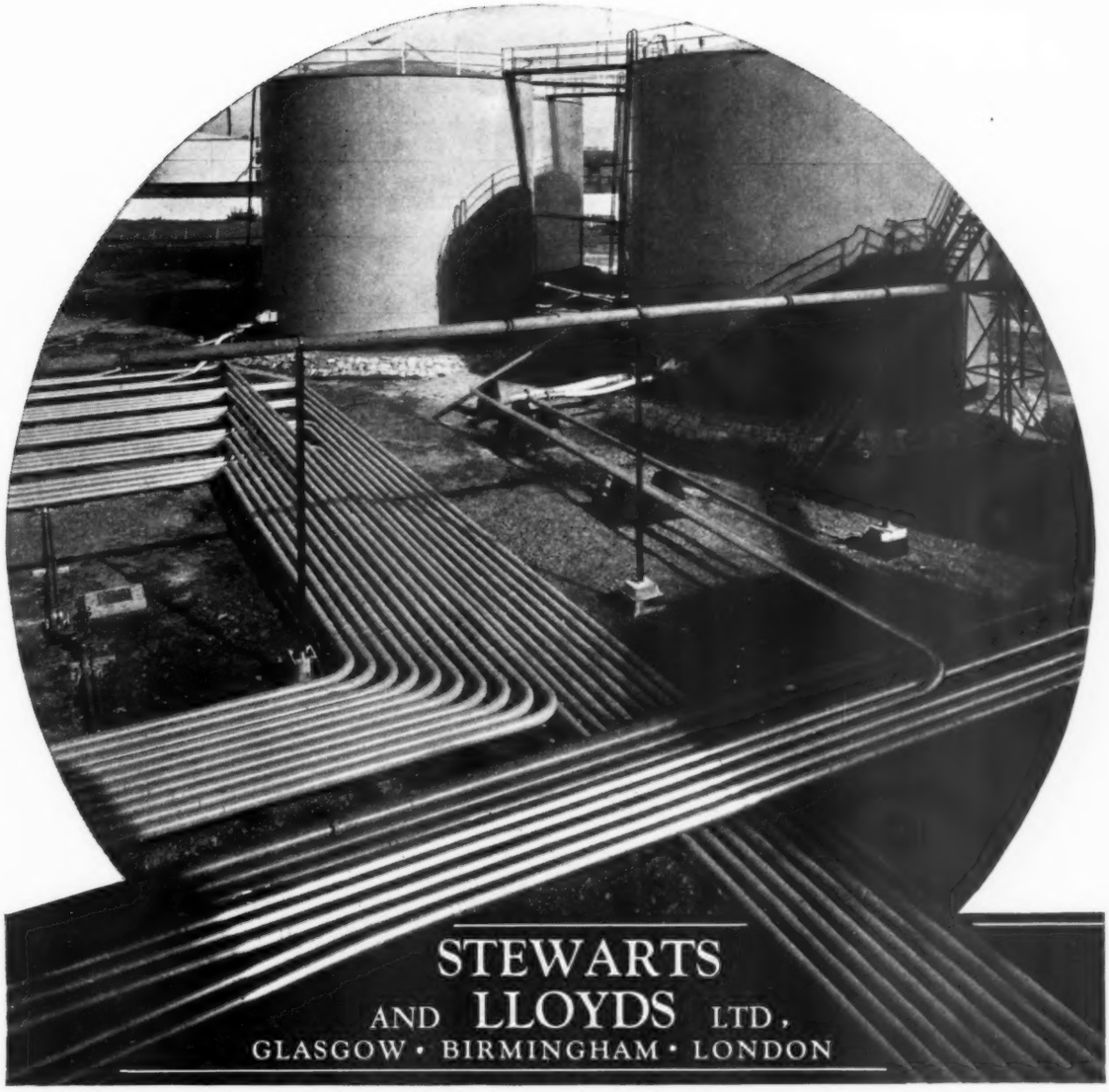
Chemico Acid Production Plants
Acid Separators and Concentrators

Consultation, design and erection with performance guaranteed

Chemical Construction Corporation

30 Rockefeller Plaza, New York, N. Y.
Cables:—Chemiconst, New York
European Representatives:
CYANAMID PRODUCTS, LTD.
233 Salisbury House, London, EC2

CHEMICO PLANTS are PROFITABLE INVESTMENTS



Steel pipe lines conveying oil, supplied, erected and welded by us for
Lobitos Oilfields Limited,
Ellesmere Port.

S&L

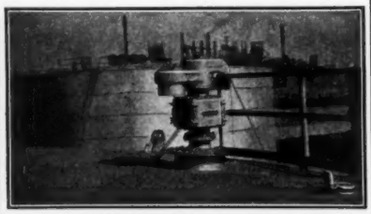
SAVE EVAPORATION LOSS . . . and PREVENT FIRE . . . with

OCECO TANK FITTINGS

Used the world over wherever oil is stored

Write for information

JOHNSTON & JENNINGS CO.
787 Addison Road
Cleveland, Ohio, U. S. A.



Klinger

LEVEL GAUGES

THIS is a specimen of the many types of Level Gauges manufactured by us. These gauges are in use up to 1000° F. temperature crude oil, and up to 6000 lbs. per square inch pressure. They are equipped with Klinger's patent sleeve packed cocks, ensuring perfect tightness under all conditions. Please write for special catalogue describing Klinger manufactures for the Oil Distilling industry.

Richard Klinger, Ltd
170, SOUTHWARK ST: LONDON S.E.1.
Phone: HOP 5344 (4 lines)

While the oil area of Baku is limited to a territory covering about 15 sq. miles, Emba oil fields cover an area of about 400 miles measuring from north to south and an area of unlimited possibilities measuring from east to west. Emba, however, lacks transportation facilities and is inaccessible to supplies, water and labor. In addition it is cut off from the outside world over a period of at least six months a year during the winter. This, of course, can be overcome only by building a railroad.

Bashkirneft, recently formed from Vostokneft, with its main field at Ishimbayevo, reports holdings of about 140,000,000 bbl. crude oil reserves, with daily average production at present around 17,500 to 20,000 bbl. per day. These figures will be increased when the extensions at Kuspiakulovo (about four miles from Ishimbayevo) and Allugavutovo come under production.

The Emba fields, together with Ishimbayevo, are already producing sufficient crude to utilize fully the Caspi-Orsk pipeline, the present figures being about 6,000,000 to 7,000,000 bbl. per year. The refinery under construction at Orsk will have a yearly capacity of 3,500,000 bbl., as will the refinery under construction at Ufa. (Ufa already has a topping plant of 3,500,000 bbl. capacity.) There will also be a topping plant at South Iskin.

All eight Saratoff cracking units are operating and six more will be built within the next year. These units will refine Ishimbayevo crude as well as Baku crude. Vostokneft is exploring for oil at Saratoff, Kuibisheff, Stalingrad, Orenburg and other places. Salt dome tectonics similar to the formations at Emba were found at Saratoff, and the strata at Orenburg is reported to be similar in nature to that of Ishimbayevo. At Kuibisheff oil in commercial quantities is reported to have been found. Vostokneft, now free of Ishimbayevo, will turn attention to exploration in various regions of Siberia, Trans-Volga and Orenburg. The head of Vostokneft is Mr. Chepikoff and the main offices are at Sterlitamak, while the head of Bashkirneft is S. Ganshin with main offices also at Sterlitamak.

In outlining the Third Piatiletka, Prof. Gubkin stated that in his opinion the technical equipment of the geological end of prospecting has not been at all improved since the Sixteenth Party Congress some five years ago. It is true that there has been little progress in this direction, due mainly to lack of appropriations. Of a total of some 800 drilling outfits of assorted types and kinds on hand, only about 400 units are fit for duty and even these are not complete with all necessary parts. A complete reorganization and mechanical reconstruction for the entire Service is overdue.

Percentage of Plan Fulfillment in Various Soviet Industries

Industry	July 1935	August 1935	Jan.–Aug. 1935	Jan.–Aug. 1934	Increase Jan.–Aug. 1935 over 1934
Coal	90.8	89.1	61.5	62.7	13.3
Pig Iron	97.9	97.2	65.4	67.0	22.3
Steel	94.1	93.5	67.8	62.1	30.5
Rolling Mills	93.6	91.0	67.7	63.6	31.0
Sulphuric Acid	90.5	92.8	64.5	54.8	27.0
Cement	100.6	92.9	....	....	33.9
Copper	98.2	81.9	66.8	47.9	58.8
Oil and Gas	81.1	80.5	57.2	54.5	3.5

Soviet Automotive Units and Motor Fuel Consumption

	1930	1931	1932	1933	1934
Motor Cars in Use	26,500	40,900	64,500	93,100	144,600
Tractors in Use (total h.p.)	746,000	1,527,000	2,295,000	2,891,000	4,035,000
Production Gasoline and Ligroin (bbl.)	14,000,000	19,600,000	20,300,000	18,900,000	19,600,000

Official Figures on Oil Operations for First Half 1935

Six months ending June 30, 1935	Official Figures	World Petroleum Estimates
Crude Production	83,794,570 bbl.	82,689,900 bbl.
Run to Stills	70,908,600 bbl.	69,003,500 bbl.
Drilling	2,260,716 ft.	2,353,689 ft.

THE organ of the Communist Party, PRAVDA, commented on Soviet oil operations in an editorial that appeared during September, the essential points of which were as follows:

> The growth of Soviet industrial development along with the steady expansion of transportation has been accompanied by an ever increasing demand for fuel, but the oil industry which showed such gratifying results during the first Piatiletka has now become the most retarded branch of Soviet Heavy Industries. The technical equipment of the oil industry has been steadily improved but proportionate gains in production have not followed. There is no adequate excuse for this situation. Soviet natural resources are exceptionally rich. The average production per well in Soviet fields is 12.7 tons per day compared with 1.4 tons per day in the fields of the United States. The development and expansion of Soviet oil lands augurs favorably for a steady growth of crude production, particularly in the east of the country. The Emba territory alone holds deposits which are four times the Grozni estimates and second only to Baku.
>
> The outstanding factors hindering progress in the oil industry are inability to organize prospecting and insufficient new drilling. Decreased production at Grozni, from 8,064,000 tons in 1931 to 3,370,000 tons in 1934 is a perfect example of what all Soviet oil fields must avoid. This drastic reduction was the price paid for the short-

RENOLD

OIL WELL CHAIN

Designed and made to A.P.I. specification by the world's leading driving chain makers.
Send for leaflet Ref. 216/32.

THE RENOLD AND COVENTRY CHAIN CO. LTD., MANCHESTER ENGLAND
AGENTS THROUGHOUT THE WORLD.

Afonin

FLOATING ROOF

Reduces Evaporation Losses and Fire Hazards

SIMPLE—SAFE—ECONOMICAL

Installations have been made WITH and WITHOUT Permanent Roofs

World Manufacturing Rights controlled by

THE AFONIN SEALING RAFT CO., LTD.
Berlin, W. 15 Bregenzerstr. 7. Germany

UNITED STATES: George W. Farny, Consulting Mining Engineer, Craftsman Farm, Morris Plains, N. J.

GREAT BRITAIN: B. J. Hesse, 117, Fenchurch Street, London, E.C. 3

FRANCE: Etabs. Delattre & Frouard Reunis, 39, Rue de la Bienfaisance, Paris. (Licensees for France)

GERMANY: Eisenwerk Wulfel, Hannover (Licensees for Italy, Holland and Roumania)

PREMAFU
71, RUE DE PROVENCE
PARIS

ROBINETTERIE RACCORDS
EN
ACIER·FORGÉ

sighted policy of concentrated production for today's needs only, giving no thought to the requirements of tomorrow and the future. Today Grozni is still deep in arrears, and the situation is aggravated by the fact that Grozni crude is a light grade containing about 24 percent gasoline, while Baku crude contains, on the average, only about four percent. During 1934 not a single new oil field has come under production except Kaya Kent at Daghestan, which is a minor producing field.

American drilling methods and speed must be introduced immediately in Soviet production, and there is not a single Soviet oil operator or driller who would deny that this is possible. Examples of efficient drilling have been given by several shock brigades at various Soviet oil fields while good drilling has become common practice at Baku, Grozni and elsewhere. Though 3,400 ft. of drilling per rig per month has been accomplished at Baku, the drilling plans remain unfulfilled, due largely to the fact that present operation at greater depths and under high pressure is an art which has not yet been mastered under Soviet practice.

Breakdowns at wells are excessive. In a total of 4,413 producing wells at Baku, about 1,000 breakdowns occurred during the first six months of 1935. During the same period there were 215 breakdowns at Stalinneft and 155 at Asisbekoffneft. A large proportion of all these breakdowns occurred because of negligence, lax discipline or improper technical supervision, and could have been prevented. Over 100 breakdowns were registered at the October field of Grozni and of this total exactly 75 have occurred during the night shift when supervision and control is at its poorest.

A breakdown usually means complete abandonment of the well, as both the knowledge and equipment for resuming operations are lacking. On the other hand, if operations are resumed, it is not until many months later. Causes of such irregularities remain uninvestigated and those to blame go unpunished. Meanwhile cost of drilling and operation mounts.

Another weak point is bringing the well to production after drilling. Twenty-seven wells were made productive at Stalinneft during July against sixty-six wells drilled and not made to produce. Considerable quantities of crude are being lost at idle wells needing cleaning or repairs. At Baku alone there are over 2,000 wells registered as idle, while under some sort of action these wells could yield sufficient crude to meet plan requirements.

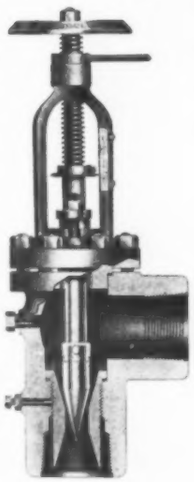
PRELIMINARY surveys for the Caspi-Orsk pipeline (Orsk to the Caspian Sea) were started in 1931. Subsequent building operations up to the beginning of 1935 made little headway. During the nine months of this year about 280 miles of pipe were laid and welded and over 250 miles of trenches dug. At the present time there are approximately 230 engineers and technicians and 4,500 laborers engaged in building the line.

Efforts are being made to have the line in operation by the end of this year, but lack of minor parts and equipment is hindering progress. The reported shortages consist of parts of Diesel engines and pumps as well as timber, cement, steel and sheet metal.

J. WEGRIN

SHAFFER ADJUSTABLE FLOW BEANS

Control the flow of oil and gas, throttling it to any desired pressure and rate of flow without having to disturb the current. Shaffer Adjustable Flow Beans are in successful use throughout the world on flow lines, wherever high pressures need controlling, or wells are prorated.



Also made in an East Texas Type to control moderate pressure wells.

SHAFFER TOOL WORKS
BREA, CALIFORNIA
HOUSTON, TEXAS

Export: Oil Well Supply Co.

Strong
Tensile 20/75 Tons
Elong. 70%/5%
Brinell up to 230
Modulus 8,000

Ingot Bar Sheet Tube Wire Sections

Tough
Izod—55/75 ft. lbs.
Fatigue range:
In Air ±15 tons □"
Sea Water ±12·5 tons □"
10^7 reversals

In the four corners of the Earth Oil Engineers specify

Tungum

THE FOUR-SQUARE NONPAREIL ALLOY
to withstand corrosion, erosion, impact and fatigue.
Please write for booklet.
TUNGUM SALES CO., Ltd., 3, Caxton St., London. S.W.1

Incorrodible
Highly resistant to Sea Water, H_2SO_4, HCl, Oil impurities, Steam, etc.
Equilibrium potential -272 volt.

Castings Forgings Gauze Rope Stampings Spinnings

Workable
Easily machined; works cold; welds; brazes; solders.
Bearing metal.
High thermal conductivity.

In America, more than 100 railroads use Gargoyle products. Abroad, the Royal Scot, the Flying Hamburger, and many another famous train relies on Gargoyle quality and Socony-Vacuum service

Petroleum products of Socony-Vacuum or its affiliates are marketed in practically every country of the world

SOCONY-VACUUM OIL CO.

INCORPORATED

26 BROADWAY · NEW YORK